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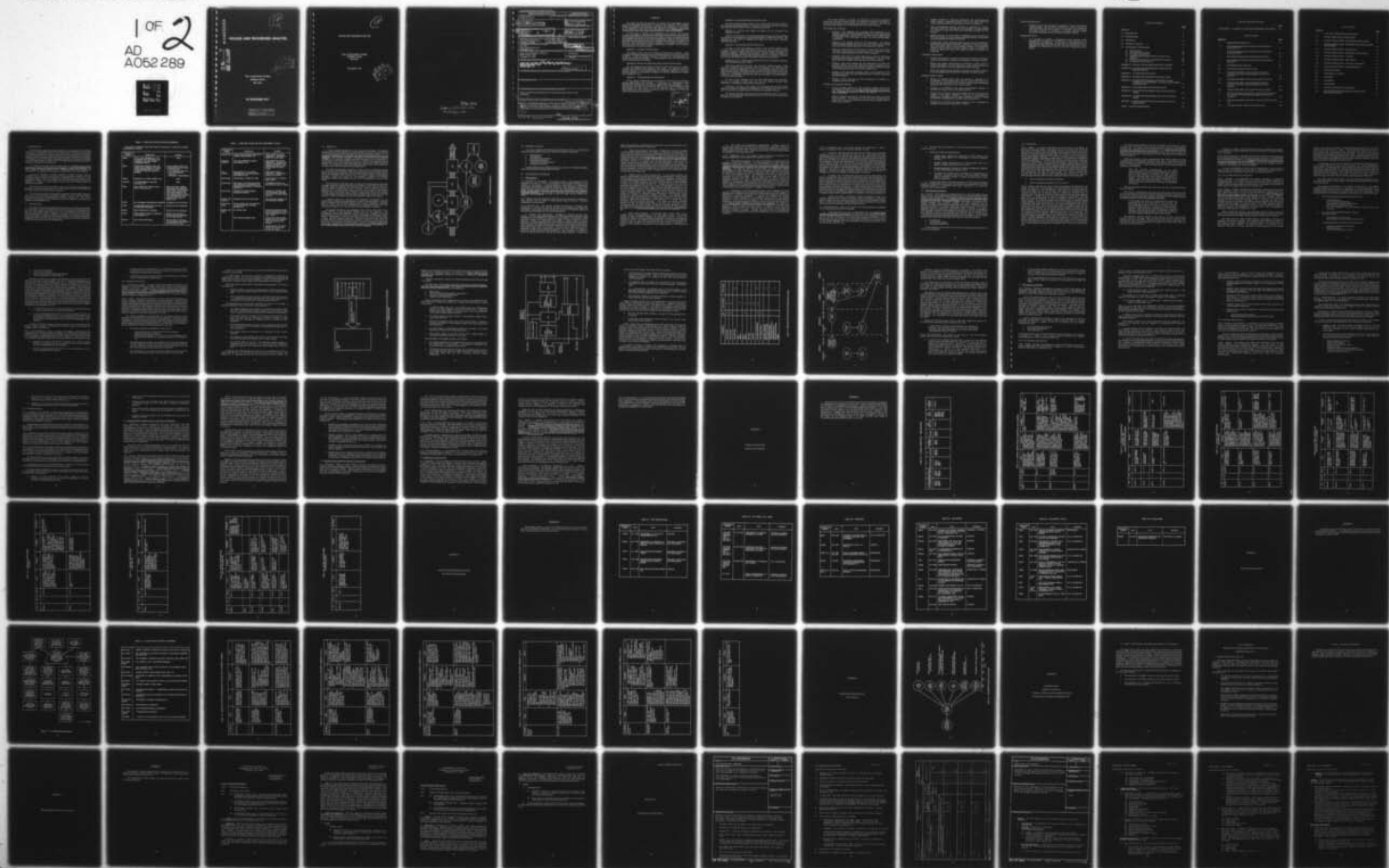
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## POLICIES AND PROCEDURES ANALYSIS

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(MAT 04T)

30 DECEMBER 1977

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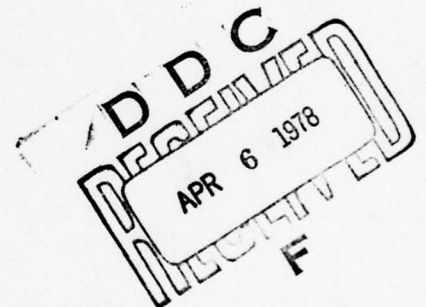


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**POLICIES AND PROCEDURES ANALYSIS**

**TEST & MONITORING SYSTEMS  
PROGRAM OFFICE  
(MAT-04T)**

**30 December 1977**



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19. ABSTRACT (Continue on reverse side if necessary and identify by block number) Survey of existing DoD programs to extract lessons learned with respect to ATE/BIT (Automatic Test Equipment, Built in test) hardware and software procurements. Review of existing Policies and Procedures (P&P) in six cost driver areas to determine updating needs and what new P&P's have to be developed to resolve discrepancies in procuring and controlling ATE/BIT. and		



## SUMMARY

This report provides and documents the results of an investigation into the policies and procedures requirements for automatic test equipment. The candidate areas for investigation were selected on the basis of their potential as a "cost driver" in ATE programs or items which have been identified in the Report on Navy Issues Concerning Automatic Test, Monitoring and Diagnostic Systems and Equipment.

Six basic issues or problem areas, addressed in the summary, were reviewed during the investigation. This policies and procedures analysis and the conclusions and recommendations provided are the result of an extensive review of standards (existing and proposed), instructions and ATE related specifications. Data and recommendations concerning the data base documents were considered too lengthy to be included in the basic text. This information is, however, considered to be valuable and pertinent to the effort and as such has been included as appendices A through H. A brief summary of each appendix is provided as follows:

### Appendix A - NAVMAT ATE Instructions

This appendix deals with ATE instructions generated by NAVMAT. These instructions have been categorized into nine separate areas, each having an ATE area of impact. A summary of each instruction is provided with recommendations for further improvement as applicable. A cross correlation with other instructions and reference documentation is provided.

### Appendix B - DoD Test and Monitoring Systems Policies and Procedures

The ATE policies and procedures activities of DoD, Air Force, Army, OPNAV, NAVAIR and NAVELEX were included in this review. This appendix provides a composite listing of ATE related documents by responsible organization, with each document defined in a broad general category (i.e. logistics, software and configuration management, etc.).

### Appendix C - ATE Related Military Specifications

On-line testing considerations as an extension of ATE which are covered by military specifications were reviewed. In particular, the specifications which addressed BIT, interface bus and test point specifications were highlighted. A top-down specification hierarchy is provided in addition to the interrelationship of these specifications and their impact on the key discussion areas. Comments and recommendations in each area are provided, as well as a description of the major subject area covered by the document.

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#### Appendix D - Revised NMC Program Plan Event Chart

This brief pictorial appendix relates to the six major ATE task areas covered in this policies and procedures analysis. The policy and procedure documents affecting each area have been reviewed, with recommendations annotated.

#### Appendix E - Excerpts From Report of Industry Ad Hoc Automatic Test Equipment Project

Industry recommendations for Operational Readiness Monitoring Systems (ORMS) and utilization of on-line and test point implementation for ORMS are provided. Also identified are the needs for standards for ORMS test points and a proposed implementation plan.

#### Appendix F - Recommended NAVMAT Instructions

A review of ATE, TPS acquisition portions of B-1 and S3A Programs were reviewed. This review revealed the need to acquire the analytical data, tools and procedures utilized in making trade-off and tester selection studies and those which establish management controls on those programs. Samples of DIDs and CDRLs are provided as a springboard for obtaining the data necessary to accommodate a managerial overview into the rational utilized in forming the final acquisition decisions.

#### Appendices G, H, I, - Policies and Procedures Analysis for Conceptual, Validation and Full Scale Development Phases

These three appendices deal with ATE acquisition related activities. These activities are based on the Acquisition Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment, and are in a work breakdown structure format for each acquisition phase. Each phase provides a detailed ATE procurement process, time phased to the acquisition processes and keyed to the weapon system procurement milestones. Each appendix also provides short term and long term recommendations for each procurement phase.

An Annex, which supplements the Full Scale Development Work Breakdown Structure, is provided to deal solely with the ATE selection process, data requirements, compatibility analysis, and cost predictions.

Attachment 1 provides a brief summary of Test Requirement Document (TRD) objectives necessary to assemble a comprehensive data package which will form the basis of and provide the baseline data for automatic test equipment decisions.

The analysis undertaken centered on a systems engineering "macro" or overview approach. The problem areas were addressed in terms of the real world requirements for automatic test systems.

The actions necessary to improve the performance of the total acquisition process are identified as specific policy and procedure requirements necessary to assure efficient selection and utilization of automatic test systems. The following provides a brief summary of the recommendations for each area reviewed:

#### Test Program Set Acquisition

- o Develop a TPS Handbook which addresses TPS development as an integrated process and provides guidance and direction concerning CAD and simulator applications. Quality control for TPSs to assure a higher degree of confidence in the TPS's ability to satisfy the fault isolation/support requirements.
- o Establish a work package concept for TPS development. This concept should encompass staffing on a team basis from initial analysis through final sell off and schedule integrated with the deployment forecasts.
- o Develop a revised AR-9 which will serve as a Navy wide (vice NAVAIR) TPS guide. This document should address the TPS development process from a time phased standpoint to assure a cohesive program.
- o Establish a policy which will require application of computer aided design (D-LASAR) and simulation models for TPS development. This policy must address the latest available technology (e.g., LSI, microprocessors).
- o Establish a policy which requires that TPS developments be funded from the prime contract and that TPS acquisition plans be integrated as key milestones into the prime system contract. Economies in the prime system contract should not be made in the TPS procurement area.
- o Establish a TPS management guideline position which addresses the TPS development process in terms of staffing work load, validation, verification and work breakdown.
- o Establish a policy requiring that TPS developments be awarded on a competitive procurement basis.

#### Automatic Test Equipment Planning

- o Provide immediate guidance for ATE acquisition managers based on the methodology proposed in the Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment shown as the Annex of Appendix I.
- o Require compulsory utilization of ATE data banks as an input to the ATE selection process. This requires that the data bank I/O specifications, access times, currency of information and cost data be validated prior to directing this utilization.

- o Establish methods for producing computerized and non-computerized support analysis. Computerized analysis such as the TEEM model will require updating to address the deficiencies as shown in Appendix G.
- o The non-computerized analysis, provided by MIL-STD-1513, requires updating to account for step function work load analysis, queueing impacts as a function of step input inrush, and optimization rationale for ATE selection.
- o Establish that BIT is a viable support methodology and that the impact of BIT at each support level and in support equipment selection (ATE & MTE) must be considered and reflected in the LCC.
- o Establish that a review of MIL-STD-1326 in conjunction with other BIT/test point/interface bus related documents is required in the ships community. This review should result in a new testability standard. This standardized standard should incorporate subsystem design criteria for utilizing test points for ORMS and assure that ORMS and SDMS compatibility is established.

#### Test/Repair Documentation

- o Establish that the level of support documentation necessary for adequate support be established in conjunction with adoption of the support concept.
- o Require that support documentation be developed in concert with the systems development, and that acceptance of the systems hardware be predicated on delivery of an acceptable documentation package.
- o Review and upgrade the documentation specifications (e.g. MIL-D-1000) to assure that documentation is provided in a uniform, consistent manner.

#### Integrated Logistics Support

- o Develop an improved TEEM model (as reflected in Appendix G) to accommodate a real world support situation, provide BIT related cost factors, all user interaction for alteration of assumed values and queueing analysis for more than one UUT across a given tester.
- o Establish an ILS checklist which allows project/program managers to benchmark the support area in a time phased manner.
- o Establish that economies in the prime equipment are not to be made at the expense of the support equipment. This can be accomplished by establishing a companion ILS for support equipment which has funding derived from but independent of the prime system procurement.
- o Establish that the prime and support system ILS (i.e., companion) be integrated, and mutually justified prior to DSARC.



#### Contractual Requirements

- o Establish a policy which institutes the requirement to have ATE selection trade-off analysis, and the effect of BIT/ATE on systems maintenance repair/throwaway justifications supplied as deliverables. This will provide the proper incentive to contractors to perform adequate analysis concerning maintenance posture and support equipment selection.

#### Configuration Control

- o It is necessary to establish a configuration control document which addresses the test program set as an entirety (i.e., test system, ID, UUT, documentation and programs). To this end, it is recommended that an upgrading and integration of MIL-STD-480, 481, NAVAIR Instruction 4120.1 Appendix C be accomplished to ensure a consistent configuration control posture.



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## 1.0 BACKGROUND

There has been a significant, continuing effort within the Department of Defense and the Navy to standardize the selection, acquisition, and implementation procedures for automatic test equipment (ATE). A great many directives, policies, procedures and other documents reflect a strong determination to reduce the proliferation of support equipment and the associated high costs of acquiring and maintaining this equipment. An integration of the ATE design, development, selection, and acquisition processes with the integrated logistics support (ILS) and weapon systems acquisition processes is mandatory if this goal is to be achieved.

As a result of the above and the issues raised in the Report on Navy Issues Concerning Automatic Test Monitoring and Diagnostic Systems and Equipment, the Marcy Report, it became apparent that a thorough review of Navy policies and procedures for the acquisition and utilization of ATE within the Navy was required.

A review of NAVMAT, NAVAIR, NAVELEX, NAVSEA, SECNAV, OPNAV, NAVSHIPS, Army, Air Force and DoD policies and procedures relating to test and monitoring systems (TAMS) was undertaken to determine areas of deficiency in the acquisition of TAMS. Also to be reviewed were TAMS related military specifications. Appendices A through C contain details of this review and include policies and procedures descriptions.

The result of this review was Table 1 which lists TAMS and related applicable documents, those which need revisions, what the revisions should cover (Appendix A) and what new policies and procedures are required.

The review also covered all existing DoD instructions and MIL-SPECs relating to ATE. The items reviewed are provided in Appendix B, with applicable military specifications and their interrelationships provided in Appendix C. This review resulted in the formulation of the requirement for and the approach to the policy and procedure areas addressed herein.

## 2.0 INTRODUCTION

The purpose of the policies and procedures task item is to provide recommendations for review, revision, and generation of new Navy policies and procedures/tools (e.g., MIL-STDs, design to guides, etc.) which will furnish guidelines and assistance to both Navy and industrial project managers in the off-line ATE and built-in-test (BIT) design, development, selection, and acquisition processes. The policies and procedures and tools developed in response to these recommendations will provide standardized management tools which will assist Navy project personnel and industrial contractors in delivering testable systems at an affordable cost.



**TABLE 1. TAMS AND OTHER RELATED DOCUMENTS**

THE NAVMAT DOCUMENTS LISTED ARE DIRECTLY APPLICABLE TO TAMS, WITH REVISION REQUIREMENTS AS NOTED.

INSTRUCTION NUMBER	DESCRIPTION	REVISION
3960.4A	POLICY AND RESPONSIBILITY FOR AUTOMATIC TEST MONITORING AND DIAGNOSTIC SYSTEMS, (ATMDS), IMPLEMENTATION OF	NONE
3960.9	ACQUISITION PLANNING GUIDE FOR ATMDS AND EQUIPMENT: BIT DESIGN GUIDE, PROMULGATION OF. (BOTH DOCUMENTS REQUIRE PERIODIC UP-DATING.)	THE FOLLOWING SHOULD BE INTEGRATED INTO THE GUIDE: <ul style="list-style-type: none"> <li>• ATE SELECTION</li> <li>• ATE WORKLOAD ANALYSIS</li> <li>• TEST REQUIREMENTS ANALYSIS</li> <li>• TESTABILITY REQUIREMENTS</li> </ul>
4440.46	INVENTORY OF ATMDS, REQUEST FOR	NONE
4120.105A	ATE PROGRAMMING LANGUAGE, STANDARD FOR	NONE
5230.8	DATA BANKS FOR ATMDS & EQUIPMENT, UTILIZATION OF	NEEDS UPDATING. COMBINE DATA BANK AND INVENTORY INSTRUCTION. COVER-CONTROL, FOCAL POINT, MIL-STD-1388, ATE CHARACTERISTICS. CONTENT-LOGISTICS MODELS, INVENTORY R&D REPORTS, GIDEP, 1634-DDC, NOSC, HOW TO UPDATE, ETC.
4790.16	DOD EQUIPMENT MAINTENANCE PROGRAM	REFERENCE ATE DATA BANKS
P-4000	ILS IMPLEMENTATION GUIDE FOR DOD SYSTEMS AND EQUIPMENTS	REVIEW FOR ATE COVERAGE
4000.29	BASIC PRINCIPLES OF LOGISTICS	REVIEW FOR ATE COVERAGE
5420.44	TMDE SUPPORT ADVISORY COMMITTEE; ESTABLISHMENT OF	REWRITE ATE SECTION TO INCLUDE PERIODIC MEETINGS BY ATE FOCAL POINTS
7000.19A	COST ANALYSIS PROGRAM	INCLUDE SPECIAL REQUIRED ATE SOFTWARE COST FORMATS AND REPORTING GUIDES

TABLE 1. TAMS AND OTHER RELATED DOCUMENTS (Cont'd)

INSTRUCTION NUMBER	DESCRIPTION	REVISION
AR8 (NAVAIR)	VAST/AVIONICS SYSTEMS COMPATIBILITY, GENERAL REQUIREMENTS FOR	BEING REWRITTEN AS MIL- STANDARDS – COORDINATE NEEDS TO BE NAVYWIDE
AR9/AR9-B (NAVAIR)	VAST TEST PROGRAMS, GENERAL REQUIREMENTS FOR	BEING REWRITTEN AS MIL- STANDARDS – COORDINATED NEEDS TO NAVYWIDE. ALSO REQUIRES BETTER TPS VALI- DATION AND STATISTICAL TOOLS.
AR10 (NAVAIR)	MAINTAINABILITY OF AVIONICS EQUIPMENT AND SYSTEMS, GENERAL REQUIREMENTS FOR	BEING REWRITTEN MIL- STANDARD – COORDINATED NEEDS TO NAVYWIDE.
MIL-STD-1309	DEFINITIONS OF TERMS FOR TMDE	NEEDS REWRITE TO EXPAND AND CLARIFY
MIL-STD-1326	TEST POINTS, TEST POINT SELECTION AND INTERFACE REQUIREMENTS FOR EQUIPMENT MONITORED BY SHIPBOARD ON-LINE ATE	RECOMMEND REVISION. TO INCLUDE DATA BUS, BIT REQTS.
MIL-STD-1399	SHIPBORNE SYSTEM/EQUIPMENT ACQUISITION MANUAL	APPENDIX 31 (SUPPORT AND TEST EQUIPMENT) REQUIRES UPDATING TO INCLUDE ORMS/ BIT, ETC.
NAVMAT INST 4120.10/A	IMPLEMENTATION OF MIL-STD-1399	INCLUDE MORE GUIDANCE ON ATE SELECTION PROCESS
MIL-STD-1513 (USAF)	TRADE STUDIES FOR THE SELECTION OF AVIONIC SUPPORT SYSTEMS, CRITERIA FOR	
NAVMAT INST 3960.9	BIT DESIGN GUIDE	EXPAND AND PROVIDE GUIDE ON BIT VERIFICATION, VALIDA- TION PROCEDURES & STATIS- TICAL TOOLS
	TEST PROGRAM DESIGN GUIDE	EXPAND AND PROVIDE MORE GUIDANCE ON TPS VERIFICA- TION & VALIDATION PRO- CEDURES.
		PROVIDE BETTER TPS VERIFI- CATION AND VALIDATION STATISTICAL TOOLS.

### 3.0 APPROACH

A systems engineering approach to this task item was adopted. The approach taken was to refine and augment in a systems engineering fashion the functional flow of ATE related acquisition and development activities as depicted in Figure 1-1 of the Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment. The material contained in this guide is structured to assist program managers, ATE acquisition managers and others associated with the acquisition of Navy hardware, both in government and industry, in relating ATE acquisition planning requirements to activities undertaken during each phase of the system acquisition process. For this reason, this document was chosen as the primary vehicle from which to conduct and initiate the policies and procedures effort.

The basic premise behind this approach is that one can not realistically propose and write policy and procedures unless one can describe the sub-processes and the logical time phased relationships of the sub-processes which make up a system process. The system processes under discussion are the ATE/BIT design and development processes. Process flow charts for the conceptual, validation, and full-scale development phases were developed and can be found in Appendices G, H, and I of this report.

The initial intent of this effort was to overlay on the sub-processes of each phase of system acquisition existing Navy policies, procedures, instructions and tools, (i.e., MIL-STDs, design to guidelines, GFE software aids, etc.) and to identify voids (i.e., situations where no tools existed to do a process). Then tri-service and industry expertise was to be solicited and researched to uncover and identify tools currently available which will fill these voids. If tools for sub-processes could not be identified or if the existing tools could not be identified, the need for new process tools would be identified. Figure 1 provides an overview of the approach taken for this project.

It became obvious to the policy and procedures investigators that the fragmentation, overlap, and the general lack of systems thinking resident in existing policy, procedures, and instructions made this task virtually impossible to undertake. That is, a clear "one for one" correspondence of existing instructions with ATE acquisition processes was, for the most part, virtually impossible to establish.

This situation dictated to the investigators that a "macro" rather than "micro" systems approach to policy/procedure analysis would be more effective. The investigators, utilizing the augmented process flow charts, proceeded to identify policy/procedure issues which had major cost drive implications in ATE/support related matters. This approach, it was felt, would bear more fruitful results than the classic "overlay" approach originally conceived. Utilizing this approach, major policy and procedure issues were then identified and verified via liaison with select project and field offices. The reference to and traceability of issues to the Report on Navy Issues Concerning Automatic Test, Monitoring and Diagnostic Systems and Equipment was also a criteria, besides cost, by which major issues were selected.



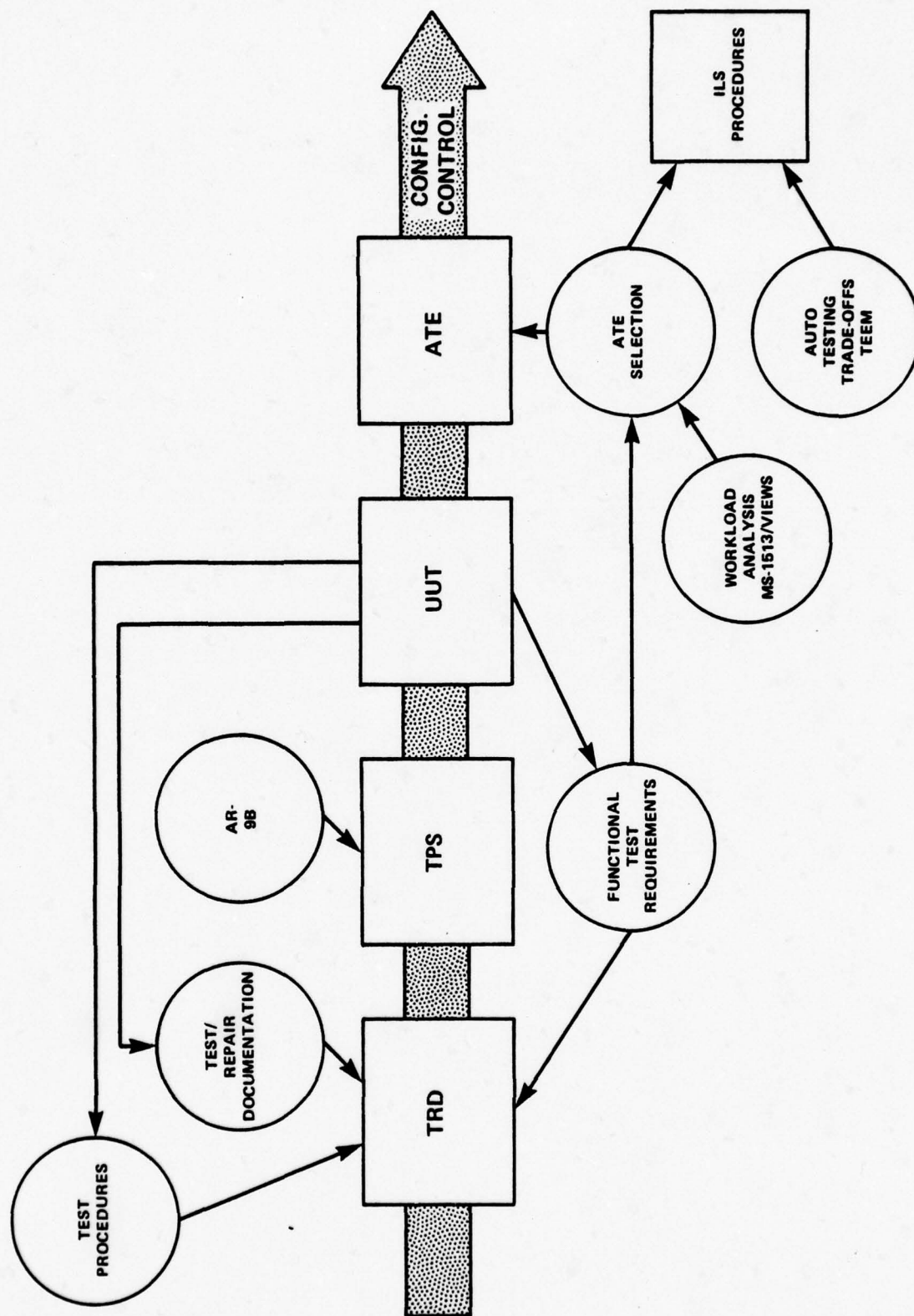


Figure 1. Policies/Procedures Objectives.



#### 4.0 SUMMARY ANALYSIS

As a result of applying the selection criteria defined in Section 3.0, the following major policy and procedure issues were selected for analysis in this report:

- o TPS Acquisition
- o ATE Planning
- o Test/Repair Documentation
- o ILS/ATE Considerations
- o ATE/Contractual Requirements
- o Configuration Control.

A brief synopsis of the findings arrived at as a result of the studies undertaken under the policies and procedures task item follow.

#### 5.0 ATE/SUPPORT COST DRIVERS

##### 5.1 TPS acquisition.

5.1.1 Statement of the problem. The complex process of test program set (TPS) acquisition has been the source of substantial criticism based principally on the outcome of the process: a product generally characterized by unsatisfactory performance and acquired at unexpectedly high costs. The unsatisfactory performance characteristics identified with Fleet use of TPSs have been described in detail in the Report on Navy Issues Concerning Automatic Test, Measurement and Diagnostic Systems and Equipment. Some rationale for unexpectedly high costs is provided in the VAST/TPS Cost Investigation (Provided to MAT 04T under contract N00014-76-C-1090).

5.1.2 Analysis. Both poor performance and high cost are symptomatic of problems for which solutions must be sought in three distinct areas of activity: technical, management and procurement.

5.1.2.1 Technical area. This activity includes the definition of standard input requirements to the process, optimum procedures and techniques for design and development, valid quality control criteria and practices, and standard output and documentation requirements for TPS use and maintenance.

a. Standard input requirements. Standard test requirements have been defined in the test requirement documentation (TRD) specification presently being coordinated by the SYSCOMs for release as a Navy standard. This document makes distinction between test requirements data needed to support different end use objectives. Detailed procedural data are specified to satisfy manual test design requirements for fault detection and isolation. Non-procedural data are specified for input to design of screening tests and test programs to be produced with computer-aided design (CAD) tools, i.e. D-LASAR. This distinction is made because of the substantial savings in test requirement documentation costs which are possible by specifying non-procedural data when appropriate. Policy guidelines are needed to provide the general criteria for making the non-procedural decision. Included with

these criteria should be a compendium of available, Navy-approved CAD systems, their general capabilities, and limits of application.

b. Design and development techniques. Although much material is available in the automatic testing literature with respect to techniques and procedures which can be used to optimize the test design and development process, most of it deals with isolated segments rather than the process as a whole. One document which treats the process as a continuum is the Program Design Handbook for Automatic Test Equipment prepared for the Navy by RCA in 1968. This document has seen wide application and is still useful. However, as is apparent from the publication date, it does not present refined techniques and procedures which may have developed in the interim. Of specific concern are testing techniques which can be translated into test programs for units under test (UUTs) incorporating LSI and microprocessor-type devices. Another area not adequately covered is the application of CAD systems previously mentioned. The need for revision of the document is recognized but a firm commitment to the revision task has not been made.

c. Quality control criteria and practices. As was stated previously, the quality of test programs arriving in the Fleet has been unsatisfactory. Quality control for test programs is exercised through the validation and acceptance functions based on statistical sampling techniques that do not necessarily address the total population of faults. For example, acceptance testing per AR-9B is based on a random sampling of faults from a fault sample selection list. Although the format for this list is prescribed, the boundaries of it are not. In short, the relationship of the list to the total fault population is not defined. While it may be reasonable to assume that the list would include all faults for which diagnostic tests have been developed, this still does not provide a measure of comprehensiveness without reference to some total number of possible faults. What results is a false level of confidence that the test program will perform its necessary diagnostic functions in the specified support environment. Notwithstanding this uncertainty with respect to the technical validity of present quality control procedures, it should also be stated that because of the effects of operational requirements on TPS deliveries, it is known that these procedures were not followed consistently. Thus, there is no certain correlation between the poor TPS performance noted by the Fleet and the quality control procedures as they are currently stated. The obvious first step, therefore, is to ensure that validation and acceptance requirements are met as specified in existing guidance documents, i.e., the Program Design Handbook for Automatic Test Equipment and AR-9B.

d. Rate tooling validation. An additional quality control effect can be realized through the implementation of the rate tooling concept. This concept employs the same ATE/TPSs developed for maintenance in place of factory test equipment to perform incoming inspection/acceptance of avionics at the integrating contractor's facility. This increases the exposure given to test programs beyond that attained during validation and acceptance and thus provides an opportunity to eliminate latent problems to the greatest extent possible before the TPS reaches the Fleet.

e. TPS output and documentation requirements. Standard output and documentation requirements for TPS use and maintenance are specified in AR-9B. In general, these requirements relate primarily to the content, organization and delivery of TPS elements used with VAST. AR-9B should be revised to accommodate standard TPS requirements in broader applications.

5.1.2.2 Management area. This activity includes requirements associated with planning, organizing and controlling the TPS acquisition process.

a. TPS acquisition planning. No specific requirements for planning the TPS acquisition process are identified in any existing guidance or policy documents, although the requirement is inferred as part of the off-line ATE support plan in the Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment. The need for projection of key events in a large-scale, complex undertaking such as TPS acquisition is obvious; the time phased relationships between the availability of TRDs, UUT hardware, trained test design manpower, test stations and other resource requirements must be established if the process is to be completed in a timely and efficient manner. The end-objective of the plan should be the availability of a full set of quality TPSs for weapon systems support on the initial operational capability (IOC) date. This planning effort can then be used by the integrating contractor as a basis for establishing subsystem/equipment development schedules to accommodate TPS acquisition input requirements in a way which will permit a gradual buildup of trained workforce to sustain the planned workload. Other timing elements to be considered when developing the plan may be the implementation of rate tooling and provisions required for competitive procurement.

b. Organization of the TPS acquisition process. The consequences of overly segmented and disorganized test program development efforts in the past suggest the requirement for a defined type of organization and workload management which can be specified for contractual compliance. In general, the individual test program development should be managed as a work package requiring continuity of personnel assigned as a team from initial analysis of test requirements through program acceptance. Basic qualifications and experience levels of team members can be found in the Program Design Handbook for Automatic Test Equipment for programs of significant complexity. No such information has been developed for relatively simple programs or those developed with ATG systems. In addition, for any major TPS development contract, few, if any, contractors have the requisite number of qualified personnel immediately available. Training requirements must be identified and implemented in training plans to provide orderly augmentation of the existing qualified work force.



5.1.2.3 Procurement area. This activity includes the mechanisms by which a contractor is selected and the TPS acquisition placed on contract.

a. Historically, TPSs have been procured from the weapon system integration contractor as part of the unpriced line item for ILS. This method has many disadvantages and most are typical of the outcome of non-competitive procurements: there is no assurance that either the most qualified or the least expensive source has been found. Of these two characteristics, the most important is the assurance that the most competent contractor has been selected. The cost issue, while not unimportant, is more difficult to deal with. No TPS cost estimating methods have been developed which can be used readily to evaluate the realism of cost quotations. For this reason, and because of the nature of the TPS development process itself, a cost type contract, awarded on the basis of most technically qualified, would seem to be the best approach. Criteria for proposal evaluation could be based on the definition of management requirements proposed in sub-paragraph 5.1.2.2 above.

b. The policy that TPS development should be procured competitively must take into consideration other contractual arrangements which might be affected. Of primary importance are the implications of such a procurement on the integration or prime contractor who otherwise may have total responsibility for ILS development, as well as responsibility for TPS acquisition inputs for other than GFE avionics. Other issues which must also be resolved are who prepares the solicitation, conducts the source selection and awards the contract. If these functions are to be performed by the government, what are the integration contractor's responsibilities at the input and output interfaces? Is he eligible to compete for the award under these circumstances? From these and other questions that suggest themselves, it is clear that further study is needed to ensure orderly implementation of a competitive TPS procurement policy.

c. Another procurement consideration requiring investigation is the use of warrantee provisions for correction of defects and/or maintenance of TPSs after delivery. These provisions can be incentivised or included in the development contract tasks. In either case, they are largely dependent on the development of valid quality control procedures and definition of defects related thereto.

5.1.3 Recommendations. Based on the results of the analysis presented in paragraph 5.1.2, the following actions are recommended:

a. Using material and structure as appropriate from the Program Design Handbook for Automatic Test Equipment, produce a TPS Design Handbook incorporating new material developed to satisfy the requirements of sub-paragraphs 5.1.2.1b and c and 5.1.2.2b. As a separate but related action, establish and initiate a task to develop valid and applicable quality control procedures/techniques for incorporation in the TPS Design Handbook and TPS requirements specifications applicable to TPS procurement contracts (5.1.2.1c).

b. Revise AR-9B and coordinate as a Navy-wide TPS requirements specification (5.1.2.1b, c, d).

c. Define and initiate the following tasks:

1. Develop policy guidelines for application of CAD systems in test program design based on an investigation of current capabilities (5.1.2.1a).
2. Develop detailed requirements for a TPS Acquisition Plan to be applied to weapon systems contracts (5.1.2.2a).
3. Develop organization, staffing and workload management guidelines for the TPS development process (5.1.2.2b).
4. Investigate the feasibility and requirements for implementation of cost-type, competitive contracts for TPS procurements, including optimum warrantee provisions. Prepare procurement policy statements as appropriate.

d. Based on these results, direct the preparation of a TPS Acquisition Guide to present at an appropriate level of detail the key events and requirements of the TPS acquisition process in a time-phased, input-output relationship to the acquisition process of prime weapon systems.

## 5.2 ATE planning requirements.

5.2.1 Overview. The acquisition and implementation of a viable ATE support concept requires certain up-front planning requirements which must be addressed early during weapon systems development. The Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment issued under NAVMATINST 3960.9 attempts to do just that. The material contained in this guide is structured to assist program managers, ATE acquisition managers, and others associated with the acquisition of Navy hardware, both in government and industry, in relating acquisition planning requirements to activities undertaken during each phase of the system acquisition process as prescribed in SECNAVINST 5000.1. However, as a result of additional inputs received from selected project and field data surveys, correspondence with cognizant tri-service and SYSCOM ATE personnel, and an analysis of the functional flow of acquisition and developmental activities in Figure 1-1 of this guide, it has been determined that additional refinement of this document is required. Policy and procedural requirements and guidance are required in the following areas:

- o ATE Selection
- o ATE Workload Analysis
- o Testability Requirements.

A brief discussion of the issues involved in each of these topics is provided in the following sub-paragraphs.

### 5.2.2 ATE selection.

5.2.2.1 Problem. A rational, straightforward, and cost-effective methodology for selecting ATE has been sought by the support community for some time. During the late sixties, the demand for this methodology was not critical because relatively few different types of ATE systems were available. ATE during that time frame consisted primarily of large-scale general purpose types (i.e., VAST) or custom versions (i.e., peculiar ground support equipment). It wasn't until the early seventies that equipment manufacturers began to comprehend the potential of the ATE market and responded by introducing equipments with hardware and software attributes aimed at particular voids in the marketplace. In some instances, equipment manufacturers introduced equipments similar to their competitors' for the primary purpose of getting into the market as quickly as possible. In other instances, equipment manufacturers introduced ATE systems which were based on technology/concepts which exemplified corporate strengths and long range marketing goals rather than the real needs of potential users. Buzz words such as "rack and stack" and "third generation" came into use and split ATE manufacturers and users into diverse camps. This condition confused many potential ATE users and weapon systems support managers in particular. Basically, these managers wanted to know how they could objectively answer two questions:

- a. When is automatic test equipment justified?
- b. How do you go about deciding what ATE to select?

5.2.2.2 Analysis. Both the Navy and Air Force have attacked these problems in one manner or another but current guidance and procedures/tools to answer these two bottom line questions is still not adequate. With respect to the second question, various data banks over the past few years have been under development by the Air Force and Navy for the express purpose of providing an objective means of selecting ATE. Although there is no direct relationship or interface among these data banks, there is a certain amount of overlap of information among them. The data banks are structured differently and each was designed to perform a separate and distinct function. All of the data banks have one common goal: to identify existing support equipment of one type or another. The Naval Air Engineering Center (NAEC) in Lakehurst, New Jersey, instituted a pin by pin matching program in a data bank to match ATE with UUTs. The Air Force's San Antonio Air Logistics Center has also developed an ATE data bank for the express purpose of selecting ATE based upon the test requirements of UUTs. The Air Force's data bank differs from the Navy's data bank in that it provides a functional requirements analysis of UUTs versus ATE in lieu of a detailed pin for pin analysis. Both data banks have their shortcomings. The Navy's data bank contains parametric data on approximately a dozen ATE systems and requires extensive upgrading to reflect what is currently in the Navy's inventory and what is currently available in the commercial marketplace. In addition, the input coding requirements for UUTs (pin information) have significant cost implications. The Air Force approach, using a functional matching concept, incurs some technical risk in the matching process because of the general nature of UUT test requirements data.



The industry's ATE project for the Navy conducted a study (Task E) of various ATE data banks. The results of this study are documented in Volume III (Management Considerations: Conclusions and Recommendations) of the Report of Industry Ad Hoc Automatic Test Equipment Project for the Navy. This report reflects the need for objective selection of ATE via a computerized data bank. However, the report also recognized that existing ATE data banks are not fully operational and/or loaded with current information.

Based upon analysis of survey data gathered, Task Group E generated several conclusions and recommendations pertaining to data banks. A good majority of these recommendations and conclusions pertained to the personnel and data requirement aspects of ATE data banks. In terms of proposed policy, the ad hoc group made the following recommendation:

After the successful implementation of the above recommendations, it is further recommended that all contracts which are ATE impacted, to the extent of \$100,000 or more, be made to contain contractual provisions that make mandatory the use of ATE data banks in such matters as ATE selection or design, in "unit under test" test program development, and in related research and development efforts. Costs incurred in using the data bank should be direct allowable charges against the contract.

This recommendation satisfies long range rather than short range policy needs in the data bank area.

With respect to selecting ATE objectively by matching ATE characteristics with UUT test requirements, the Air Force made the following statement at the recent (15-16 June 1977) tri-service briefing on automatic testing in its paper, The San Antonio Air Logistics Center Automatic Test Equipment Data Bank:

At the present time, there is no standard vehicle to apply the requirement for use of the data bank to new contracts. We have recognized for quite some time, the need for a data item description (DID) requiring a contractor to deliver properly coded test requirements for screening against the data bank. However, action was delayed until we progressed through the conceptual and development phases and were assured the data bank was a capable screening tool and would be utilized.

This approach is directly opposite to that taken by the Navy. By NAVMAT Instruction 5230.8 (14 November 1974), the Deputy Chief of Naval Material made mandatory the use of data banks. Despite this instruction, inquiries made relative to ATE selection process from November 1974 through 23 July 1976 were minimal to nonexistent at these data banks.

In summary , it appears that an alternative short-term methodology and guidance to the ATE selection process independent of data bank utilization is required in support of Navy programs.

5.2.2.3 Recommendations. In the light of the previous discussion, immediate guidance and methodology pertaining to the ATE selection process is needed. It is recommended that this guidance be provided in the Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment. The Annex of Appendix I describes a proposed methodology which may be integrated into the ATE Acquisition Guide to provide short term guidance to acquisition managers.

It is also recommended that data band I/O specifications, access turnaround times, currency of information, and cost data be published and validated prior to requiring compulsory utilization of these resources via policy directives.

### 5.2.3 ATE workload analysis and justification.

5.2.3.1 Problem. No standardized Navy policy, procedures, or operational methodology exists for justifying ATE, or for performing cost benefits/trade-off and workload analyses. As a result, proliferation and the uneconomical utilization of support resources results because no uniform means of measuring or ascertaining the effectiveness of one support alternative over another exists.

5.2.3.2 Analysis. A number of procedurally oriented tools currently exist which enable project managers to objectively conduct cost benefits/trade-off analyses of ATE with other support alternatives. The Air Force's MIL-STD-1513, Trade Studies for the Selection of Avionic Support Systems, Criteria for, and the Navy's Test Equipment Effectiveness Model (TEEM) are two tools available to project managers. However, they are not operationally suitable for Navy application at this time. The TEEM model provides the ILS and acquisition manager a tool to evaluate what type of test equipment to place at each repair site. Results indicate placement which will achieve the most effective support of a weapon system. The model evaluates results of assigning one of three tester categories: built-in-test, off-line manual test equipment (MTE) and automatic test equipment to a specific site. The site locations are identified as organizational, intermediate or depot.

TEEM is intended for use early in the development phases of a system acquisition process. To this end, the model has been maintained relatively simple with limited input requirements commensurate with limited data availability and accessibility.

The output from the model provides reports on availability, quantities, cost breakdown and sensitivity analyses. The availability report indicates a measure of performance of the test equipment by showing availability of the prime system for each identified support method. The quantities report is an indication of test equipment utilization. It provides information concerning numbers of test stations

needed for each tester type, number of trained personnel to operate testers, wait time in queue and number of items in queue. The cost breakdown provides a printout of both recurring and non-recurring costs. Recurring costs include areas such as transportation, labor, space and test equipment support. Non-recurring costs address acquisition of test equipment and other on-time costs. The sensitivity analysis report provides information on changes experienced in number of tests required, prime system spares requirements and probability of testers being utilized for changes in mean time between removals of assemblies the tester checks.

It is important to note that the model does not satisfy the requirements for a level of repair (LORA) or life cycle cost (LCC) analysis. It is instead a supplement to those analyses. Generalized repair versus discard decisions, for instance, should be made prior to using the model. If a tentative LORA decision has not been made, the analyst must make several runs of the model, varying the test scenario to cover the most probable LORA decisions. Also, a complete LCC analysis must consider cost categories which the model does not include. In summary, the model is basically a sensitivity analysis tool which can be utilized in selecting support alternatives.

The TEEM model contains certain technical deficiencies (Appendix G) which were identified during the early stages of the policies and procedures effort and are now being rectified.

The purpose of MIL-STD-1513 is to effect the selection of a test support configuration (automatic, manual, or a combination) for avionic systems that can be optimally utilized at specific levels of maintenance. This selection process is based upon performing trade studies to determine the optimal test configuration. The standard requires that the following studies be conducted as part of the trade studies:

- o Preliminary Engineering Analyses and Decision Studies
  - UUT Identification
  - UUT Functional Characteristics
  - Test Equipment Component Identification
  - Interface Hardware Identification
  - Test Set Component Cost Determination (recurring and non-recurring)
- o UUT versus Test Requirements Matrix Analyses
- o Workload Analyses
  - Determination of UUT Arrivals
  - Determination of Off-line Test Station Test Times
- o Conceptual Synthesis of ATE and MTE Configurations
  - Application of Effectiveness Criteria
  - Queueing Analyses
  - Test Station Optimization Analyses



- o Life Cycle Cost Analyses
- o Cost Effective Analyses
- o Optimal Test-Support Configuration Analyses
- o Optimum Repair Level Analysis (ORLA).

MIL-STD-1513 falls short in detailing procedurally as to how one arrives at the optimum ATE support vehicle to support "n" UUTs. It is generally recognized in the ATE community that the optimization procedure is a complex interactive process. MIL-STD-1513 does not impose any specific analysis or methods to arrive at an optimum ATE configuration. It only requires that all rationale be documented and submitted to justify the configuration and optimization techniques. Thus, a mystique is cast about the process by which one optimizes or selects an ATE support vehicle. Unless this mystique is dispelled, project personnel will not carry out life cycle cost trade-offs between general purpose electronic test equipment (GPETE) and ATE, and test equipment proliferation and support costs will continue to escalate. In addition, the methodology utilized for predicting UUT workload is based upon workload derived from a typical air wing operational scenario. This scenario assumes a uniform arrival rate of UUTs over a given period of time and does not address the various real life workload scenarios which are peculiar to ships interfacing with depots, intermediate maintenance activities (IMA), and tenders where arrival and service rates of support equipment are time dependent such as in:

- a. A "rush hour" scenario of "n" UUTs to be serviced in a finite period of time "t" to meet specified mission availability requirements.
- b. A priority queueing scenario where "n" UUTs arrive after "x" UUTs are in the process of being serviced by a tester and warrant immediate service. The probability and the impact, from a readiness point of view, on the average wait in the queue for each of the "x" UUTs is not addressed in MIL-STD-1513.

In addition, MIL-STD-1513 does not require that life cycle cost trade-offs of BIT (another support equipment alternative) be conducted along with manual test equipment and ATE alternatives.

5.2.3.3 Recommendations. There is a need in the support community for both computerized and non-computerized methodology for performing cost benefits and workload analyses. As stated previously, an analysis and recommendations pertaining to the computerized TEEM model can be found in Appendix G. With respect to the non-computerized approach (MIL-STD-1513), the following recommendations are made:

- a. Research and update MIL-STD-1513 queueing and workload analysis equations to reflect both air and sea applications with particular emphasis on rush-hour queueing and priority queueing.
- b. Provide more guidance in MIL-STD-1513 as to the methodology by which an optimum support vehicle is selected.

- c. Provide guidance in MIL-STD-1513 as to how life cycle costs for Navy programs are to be derived. MIL-STD-1513 presently references Air Force documents to perform these calculations.
- d. Include BIT as a support alternative which must be traded off with ATE and MTE at a specified level of maintenance.

#### 5.2.4 Testability requirements.

5.2.4.1 Statement of problem. The lack of BIT, system readiness information, and amenability to off-line testing of weapon systems has caused severe maintenance problems in the Fleet. A standard which will require that new prime equipment contain these features is needed. The Report on Navy Issues Concerning Automatic Test, Monitoring and Diagnostic Systems and Equipment identified those issues as problem numbers 17 (lack of effective built-in-test), 18 (lack of command information), and 20 (items not amenable to test).

5.2.4.2 Analysis. The specification of BIT, test point, and interface standards is a means of imposing testability requirements on prime equipment. During the past decade, NAVAIR has imposed such requirements on prime equipment manufacturers by imposing AR-8 (general requirements for versatile avionics shop test system/avionics systems compatibility) and AR-10 (general requirements for maintainability of avionics equipments and systems). With respect to the ship side of the house, one of the first attempts at establishing testability requirements on prime equipments design was the generation of MIL-STD-1326 (test points, test point selection and interface requirements for equipments monitored by shipboard on-line ATE).

This standard establishes the requirements for providing test points in prime equipments for monitoring by on-line automatic test equipment. It provides criteria for guidance in optimum test point selection. It also defines certain interface and data requirements, a system of test point data generation, and procedures for submission of data disclosing the selection of these test points. It is the intent of this standard to specify requirements to achieve the following testability objectives:

- a. The optimum selection and placement of test points to:
  - Continuously monitor the performance of prime equipment.
  - Detect the existence of a failure.
  - Facilitate rapid isolation of a failure to the line replaceable unit to effect repair by substitution of a spare, performance of realignment, etc.
- b. The planning and development of an adequate level of test logic design for the prime equipment in order that the ATE can be programmed to provide optimum monitoring of sensor outputs, and to ensure timely delivery of the end article and all of the required test point information.
- c. The specification of the types of test point signals and their associated electrical characteristics which must be provided for ATE monitoring.

Figure 2 is a pictorial rendering of the effect MIL-STD-1326 has had on prime equipment interface design.

As noted earlier, the test point interface is predominantly analog and is unidirectional in nature. Also note that for some test point signals, signal conditioning sensors had to be built into the prime equipment in order to make compatible the characteristics of these test point signals with those specified in this standard.

MIL-STD-1326 has certain distinct advantages and disadvantages. The primary advantages are:

- a. Placing a bound on the types of measurements and electrical characteristics of test point signals reduces the need for overly complex off-line ATE.
- b. The recommended test logic approves of utilizing the specified test points is a straightforward approach of sequentially monitoring a separate set of test points for each unique mode of prime equipment operation.

The disadvantages or shortcomings of MIL-STD-1326 appear to far outweigh its apparent advantages. Some of the primary disadvantages are:

- a. The standard addresses the requirements for establishing standard analog test point interfaces between prime equipments and specialized on-line testers. Digital test interface standards are not addressed in this standard.
- b. The standard specifies a boundary on the electrical characteristics of test points and the types of measurement capability available for their monitoring which increases the complexity and cost overhead of prime equipments.
- c. The recommended sequential test logic concept proposed by MIL-STD-1326 is for the most part more compatible with analog/RF equipments than for digital equipments.
- d. The standard contains no reference to or requirement for BIT in prime equipment.
- e. The standard is not compatible with current prime equipment technology and recent developments in shipboard data multiplex systems.
- f. The standard does not provide to the subsystem designer guidance in establishing how test point data is to be formatted and utilized for operational readiness monitoring system (ORMS) application at the ships level.

In light of these disadvantages, the ships community embarked on an effort to update MIL-STD-1326 to an "A" revision in order to rectify its shortcomings. The requirement for upgrading MIL-STD-1326 was identified during the Navy's ATE



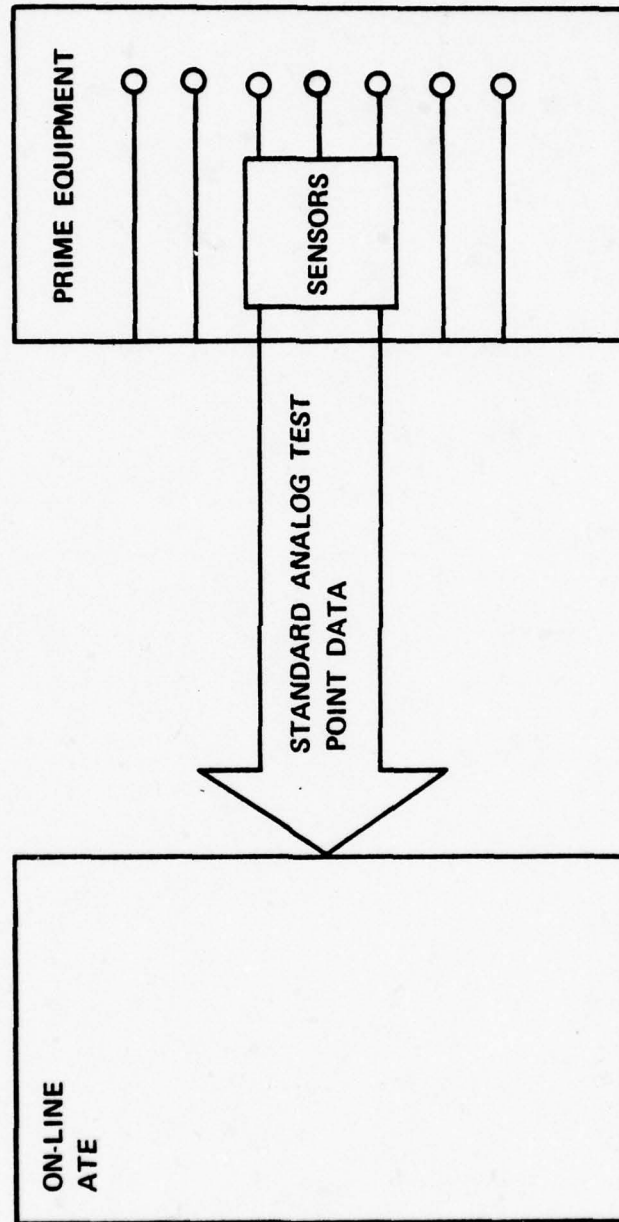


Figure 2. ATE Interface Requirements Imposed on Prime Equipments  
by MIL-STD-1326.

program review meeting in August of 1976. In addition, the shortcomings of MIL-STD-1326 received a considerable amount of attention in the Report of Industry Ad Hoc Automatic Test Equipment Project for the Navy - Volume III Management Considerations.

Appendix E contains key excerpts of comments pertinent to MIL-STD-1326 made in this report.

MIL-STD-1326 is entitled Test Point, Built-in-Test and Test Interface Requirements for Navy Operational Systems. This proposed standard attempts to impose the following testability requirements on prime equipments:

- o Built-in-test
- o Test point selection and placement requirements
- o Test point multiplexing requirements
- o Digital data bus requirements.

Figure 3 illustrates, in block diagram format, the impact the proposed MIL-STD-1326A would have on equipment architecture if imposed as a specification. It should be noted that:

- a. A standard digital data bus is the principal means of communication between the prime equipment and remote off-line ATE. Analog test stimuli would require digital to analog conversion while analog responses would require analog to digital conversion.
- b. An analog interface provides a means of monitoring key signals continuously via on-line ATE.
- c. Test point multiplexing under control of the BIT processor is utilized to minimize the number of wires required between the on-line ATE and the prime equipment.
- d. An access panel for maintenance personnel is provided at the prime equipment to provide access to analog test points.
- e. Also, manual control of the BIT function and a digital display for maintenance purposes would have to be provided.

The advantages of the proposed standard are as follows:

- a. The standard addresses prime equipment BIT, test point, and digital data bus requirements in one document - all testability requirements are enumerated under the umbrella of one document.
- b. The standard requires, whenever possible, the multiplexing and conversion of all analog test point data into a digital format for transmission over a standardized digital data bus, thus minimizing intra-ship cabling requirements.

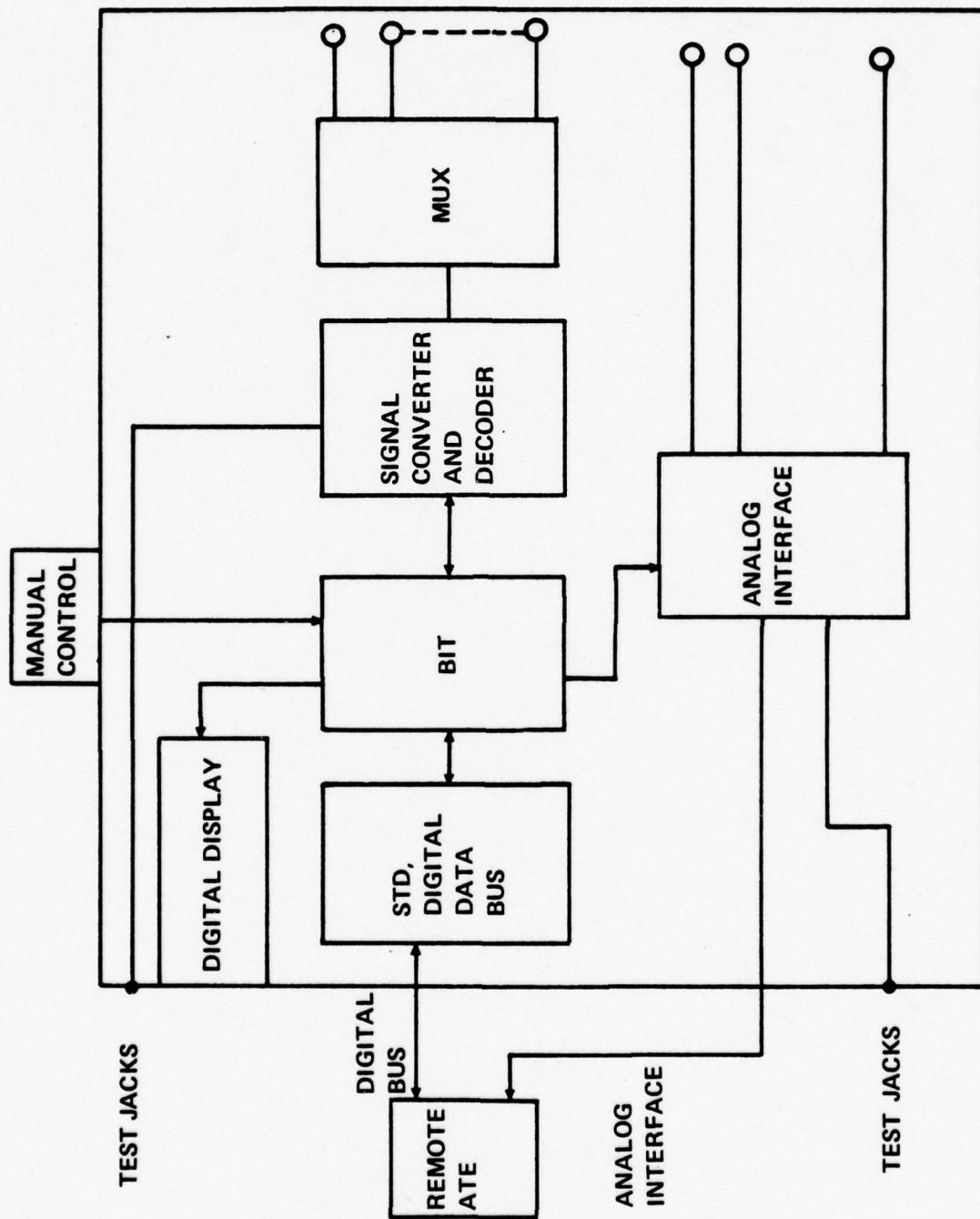


Figure 3. ATE Interface Requirements Imposed on Prime Equipments by MIL-STD-1326A.



Some of the shortcomings of MIL-STD-1326A are as follows:

- a. The standard does not specify analog interface requirements between prime equipment and on-line ATE. That is, no electrical bounds in terms of voltage and frequency are specified for test point and performance monitoring signals.
- b. The standard does not specify the characteristics and measurement capabilities of the on-line ATE that the prime equipment will interface with.
- c. As in MIL-STD-1326, this standard does not provide guidance to the subsystem designer in establishing how test point data can be formatted and utilized for ORMS application at the ships level.
- d. MIL-STD-1326A, despite its functional attributes, is another standard in a maze of BIT/test point/data bus standards.

Figure 4 amplifies this last point. This figure depicts in matrix format eleven major BIT/test point/interface bus related documents. Appendix F provides in summary format the scope, contents, and general information on each of these documents with respect to Figure 4. Note that only the proposed MIL-STD-1326A provides BIT, test point, and data bus specification requirements in one document. However, perusal of this matrix quickly brings two obvious questions to mind:

- a. How does MIL-STD-1326A interface or overlap with these specifications or documents?
- b. In the light of the existence of these documents, is the need for a new specification really warranted?

Figure 5 depicts the interrelationships of the documents noted on the previous matrix. All documents drawn in dotted ellipses with a star (\*) internal to them are documents which are evolving and have not yet been officially released. All other documents drawn in dotted ellipses without a star (\*) internal to them are released documents undergoing revision at this time. Arrows interconnecting ellipses in an oblique or horizontal manner indicate a casual connection between these documents. Arrows emanating from one ellipse perpendicular to another ellipse in a top-down manner indicate a strong connection between documents (i.e., MIL-STD-1399 references MIL-STD-1326 for guidance in shipboard test point design). A dotted arrow indicates that an implied relationship should/could exist between two documents, one (or both) of which is yet to be released.

An analysis of Figure 5 indicates that coordination in effecting data bus standardization is being worked on across Navy SYSCOM and service lines. This area appears to be receiving proper attention with respect to the establishment of common data bus standardization requirements.

DOCUMENT	BIT	TEST POINTS	DATA BUS
MIL-STD-454	X	X	
MIL-STD-415	X	X	
MIL-STD-1553			X
AR-8 (MSXX)		X	
AR-10 (MSYY)	X	X	
MS 1399		X	
MS 1326		X	
MS 1326A (PROPOSED)	X	X	X
BIT DESIGN GUIDE	X		
GENERAL PURPOSE MULTIPLEX SYSTEM			X
STANDARD SIGNAL INTERFACES TO NAVY SHIPBOARD DATA MULTIPLEX SYSTEMS (SDMS)			X

Figure 4. Major BIT/Test Point/Interface BUS Related Documents.

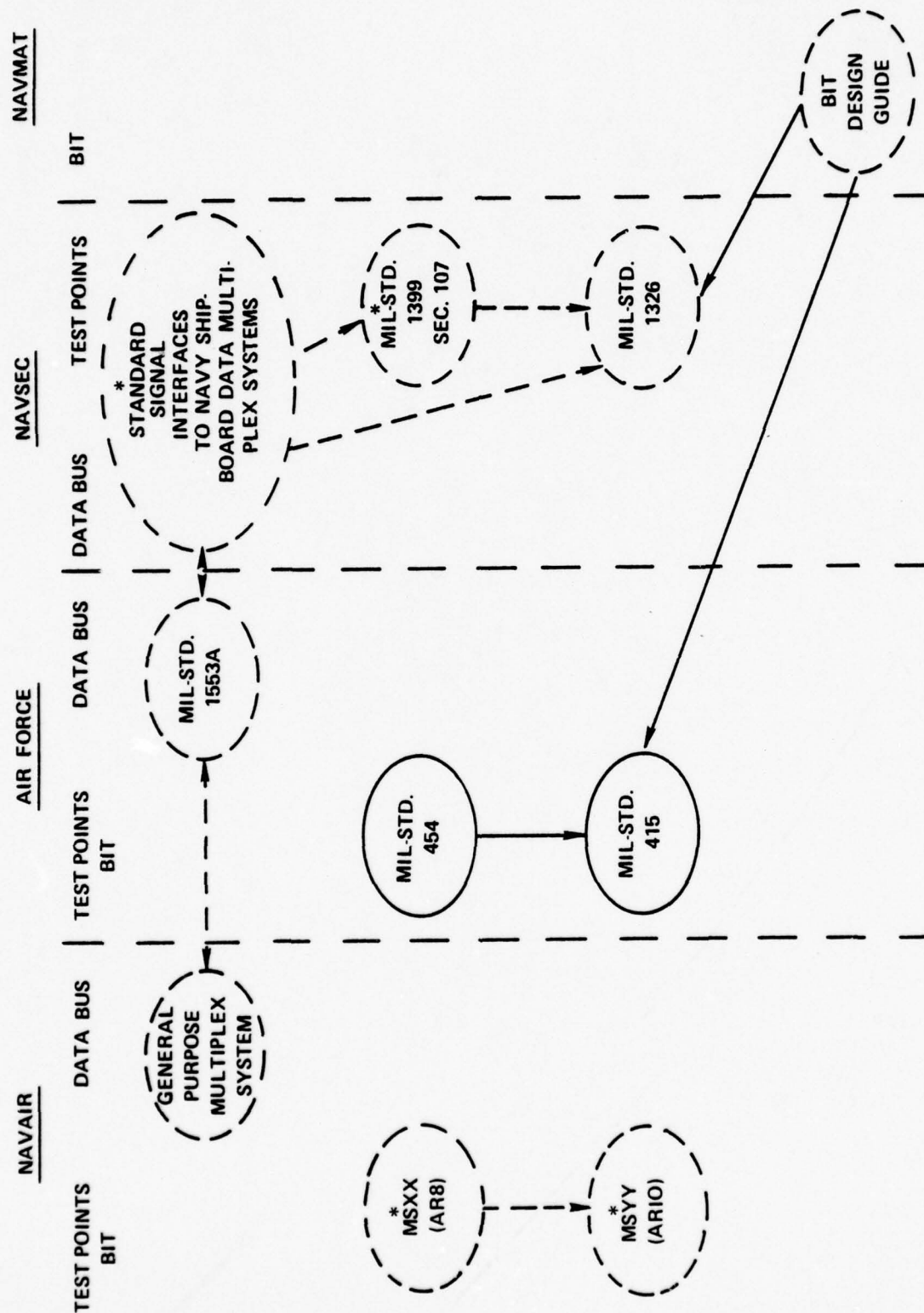


Figure 5. Interrelationship of Major BIT/Test Points/Data BUS Related Documents.



However, a state of flux appears to exist at the moment. This situation is due primarily to the problems incurred in integrating individual data bus requirements from different service branches into a universal document. Coordination of this effort has received attention at high management levels within the Navy. The adoption of a universal data bus standard would achieve cross platform (aircraft/ship) interface standardization both within the U.S. and throughout NATO.

The future effect of this effort on ATE and testing technology would be beneficial in that the communications data bus protocol adopted could also be utilized as an ATE/UUT communication standard. Such a standard could effect a reduction in the number of unique hardware/software data communication interfaces required for automatic test systems.

With respect to test point and BIT requirements, Figure 5 indicates that no solid or dotted horizontal connection appears across SYSCOM or service lines. Figure 5 also indicates that there is an absence of a BIT related standard in the ships community for prime equipment. Note that the air community covers this void in its arena via AR-10 which is slated to become a MIL-STD in the near future. Figure 5 demonstrates that this situation coupled with a rather specialized and outmoded (i.e., analog only) interface specification (i.e., MIL-STD-1326) and the new felt presence of an evolving shipboard signal interface specification makes a strong case for generating a new BIT/test point/interface related specification for prime shipboard equipments. However, perusal of Figure 5 makes one ask the question "Why generate another specification in the wake of the plethora of documents available to use?" Better yet, one might ask "Why not come up with a universal (i.e., standard) BIT/test point/data bus standard?" For the uninitiated, such an approach may seem sensible. However, this approach is not compatible with the lessons learned from prior association with such tasks.

Perhaps the comments made by industry under Task I (Specification Review) of the Ad Hoc project for the Navy best exemplifies this point:

...wide diversity of devices and components now supported by automatic test equipment makes very difficult and perhaps undesirable the broad standardizing of test points, measurement data parameters, and values thereof.

5.2.4.3 Recommendations. With respect to the need for a new ship testability standard, the following recommendations are made:

- a. A review of the proposed MIL-STD-1326A in unison with other BIT/test point/interface bus related documents indicates that such a document is needed in the ships community. However, it is recommended that the proposed MIL-STD-1326A as it presently stands not be the vehicle by which this standardization process be effected. The proposed standard as it stands now is in conflict with other testability documents. It is recommended that the revision of MIL-STD-1326 continue utilizing the draft of MIL-STD-1326A and be coordinated with existing standards and Navy project efforts (i.e., ORMS and SDMS).

- b. In the revised standard, establish the criteria which should be used in subsystem design for determining the output data requirements for ORMS. That is, establish how to use existing test points and outputs to define the various levels of equipment operational readiness.
- c. In the revised standard, ensure that the electrical characteristics of all test point interface signals are specified to be compatible with ORMS and SDMS.

### 5.3 Test/repair documentation.

5.3.1 Overview. Technical documentation in support of ATE TPS development and operational deployment has in the past had serious deficiencies. These deficiencies, addressed in the Marcy Report, primarily deal with the content and the untimely delivery of technical documentation to operational personnel.

Since 1972, module schematics, parts lists, and training have usually not been procured with NAVSEA equipments in order to minimize initial system acquisition costs. NAVAIR, who earlier tried this approach, found it counterproductive and was forced to resume procurement of module schematics, parts lists, training, and other test/repair documentation with each equipment procurement. Therefore, modules procured for NAVSEA equipment after 1972 are usually coded for depot (or manufacturer) repair or throwaway because the documentation needed to effect Navy organic repair/test of modules/printed circuit boards (PCBs) is not available. This support posture has seriously stressed Operations and Maintenance, Navy (O&MN) funding for operational systems and has had a detrimental effect on the life cycle costs for operational systems.

A policy requiring project managers to consider the cost/benefits of procuring test/repair documentation during initial system acquisition phase is required. Documentation required in support of ATE may be classified into three general categories as follows:

- o UUT Test/Repair Documentation
- o ATE System Documentation
- o TPS Documentation.

A brief description of each of these documentation elements follows with a statement of problem as it relates to each element, analysis undertaken, and proposed recommendations to rectify the anomalies identified.

### 5.3.2 UUT test/repair documentation.

5.3.2.1 Problem. The data items necessary to support UUT test/repair are untimely, unclear, disorganized, non-standardized and inadequate for timely troubleshooting (reference Marcy Report 13 February 1976).

5.3.2.2 Analysis. The key issue concerning the preparation, quality and delivery of adequate test/repair documentation is cost.

Acquisition managers argue that to require them to procure TRD specified documentation will inflate their initial weapon system acquisition costs. But the fact of the matter is that the cost and benefits derived from acquiring source documentation must be traded off over the life cycle of a weapon system program. That is, the initial investment "P" in test/repair assets made in year one of system acquisition will ultimately result in an operational savings of "S" dollars per year. The initial investment "P" consists of the following:

$$P = \$ \text{TRD Acquisition Costs} + \$ \text{Test Program Set Acquisition Costs} + \$ \text{ATE Acquisition Costs} + \$ \text{Recurring Costs}$$

The savings "S" is the reduction in O&MN funds brought about by effecting organic off-line support for UUTs. The savings "S" consists of the following:

$$S = \$ \text{Contractor Support Costs} + \$ \text{Pipeline Costs} + \$ \text{Inflated Logistics Support} + \$ \text{Contractor Depot Repair Costs}$$

Thus, it can be seen that the cost/benefits accrued by procuring test/repair documentation are often difficult to quantify since the rate of return on investment or operational savings derived from it is a function of the investment in and application of other capital investment assets.

A vehicle currently exists to specify documentation type, format and quality of data to be procured in support of repairables. This major baseline document is the test requirements document.

This document consists of the primary specification and four appendices. The purpose of the document and each appendix is summarized and provided as Attachment 1.

The data elements which are defined by the TRD, will uniformly request the same elements provided by the contractor. Past experience shows, however, that while the same specifications are used for drawings, test documents, etc. (i.e., MIL-D-1000), the end products often vary widely in clarity, information provided and the format which presents the required information.

A review of NAVAIR Instructions 4720.4 and 5600.20A provides a detailed policy and procedure for dissemination/promulgation of documentation and change information. However, this distribution scheme is based on the premise that the original documentation has been procured in a timely, efficient, cost effective manner. These instructions do not establish where in the procurement cycle to develop the necessary documentation.



5.3.2.3 Recommendations. After a review of policy and procedure concerning documentation as well as consideration of the commentary provided in the Marcy Report and the NAVAIR ATE documentation meeting (26 February 1976), the following recommendations are made:

- a. Establish a policy requiring that test/repair documentation for operational systems/equipments be acquired based on the maintenance concept adopted.
- b. Establish within this policy that test/repair documentation be procured during system acquisition. OPN funds rather than O&MN funds, must be identified for documentation.
- c. Establish a review and revision of MIL-D-1000 to assure uniform quality of data delivery. A procedure to improve drawing preparation and quality, which is included in the procurement contract, is required if MIL-D-1000 update is not practicable.
- d. Establish a policy that UUT documentation be deliverable concurrent with system/equipment deployment.
- e. Establish a policy which will identify the following as the minimum data requirements:
  - Functional signal flow diagrams
  - Maintenance manual type document for the WRA & SRAs.

### 5.3.3 ATE system documentation.

5.3.3.1 Statement of the problem. In consonance with the total system procurement concept, the ATE selected to support the UUT will have been established. In many cases, the documentation necessary to support the ATE test tool is in a state which does not allow adequate use of the tool. The ATE becomes a mystery machine, with its own set of anomalies and maintenance problems.

The lack of adequate uniform documentation and information results in another element which must be repaired, maintained and processed through the repair pipeline. Downtime in the ATE, which becomes extended due to lack of documentation, causes increasing queues of prime equipments which become backed up awaiting test.

5.3.3.2 Analysis. ATE systems which reflect new developments have the same inherent problems as UUT development programs. The cost factors of initial documentation procurements coupled with hardware procurements tend to convince the procuring activity that the initial costs (i.e., "P") will be excessive. Applying the life cycle cost analysis to the ATE program as an entity will result in a more constructive, viable procurement posture. As indicated in the Marcy Report, the ATE becomes under utilized and ineffective due to poor, limited or nonexistent documentation.

Establishing the maintenance philosophy of the ATE, or modifying the maintenance philosophy of existing ATE, is of paramount importance during the ATE selection process. Providing auto check, automatic fault detection and BIT will minimize the maintenance manhours necessary to support the ATE.

The documentation requirements for the ATE must, of necessity, address a much broader spectrum of performance variables than the UUT. The documentation must allow for resolution of conflicts between the UUT and the ATE, as well as isolation to major elements within the ATE system. Further isolation to the faulty major element subassembly and, on an optimum basis to the piece part. Maintenance of the ATE, through constructive use of a fully comprehensive design guide will allow the ATE to be maintained on the lowest organizational levels, thereby assuring that ATE achieves its primary function of supporting the UUT.

5.3.3.3 Recommendations. For newly developed equipments, the maintenance philosophy of the ATE must be established early. These requirements should reflect the highest possible level of self maintenance.

The documentation phase of the development program must clearly define, by contract, the data items necessary for Fleet support, as well as a technical narrative to describe the performance requirements.

Definition of an overall system interface specification, as well as a detailed document package to verify the functional interface parameters, is mandatory. Major element performance parameters will also be required to achieve further isolation. It would be preferable to have this function self-contained within the ATE system.

In order to resolve the problems as outlined in the Marcy Report which concern ATE documentation and ATE maintainability, the following is recommended:

- a. Establish a policy which will require the highest levels of ATE self maintenance (i.e., self check, self test, self calibration, etc.) as practical within the constraints of the overall program performances (i.e., cost/schedule).
- b. This policy shall define, after establishing the level of self maintenance, the minimum data required for support of the ATE. These data shall include, but should not be limited to:
  - Operator/operation instruction
  - Overall system manual
  - Major functional element manual
  - Diagnostic manual
  - Calibration manual (adjustment/alignment)  
will be a function of the self calibration available
  - Laboratory calibration manual.

- c. Establish within this policy, the minimum quality acceptable for deliverable data either by specifying the requirement or modifying the existing specifications (e.g., MIL-D-1000) as noted in 5.3.2.3.
- d. Establish within this policy, that all required technical support documentation be delivered concurrent with the ATE system deployment.

#### 5.3.4 TPS documentation.

5.3.4.1 Statement of the problem. TPS development programs, most often produced by a prime weapon systems contractor, have not provided adequate documentation to accommodate organic support utilizing ATE. The result has been increasing logistics problems in terms of good UUTs being returned for repair and bad UUTs being certified RFI. The impacts of these conditions are obvious both in the Fleet readiness posture as well as O&MN cost impacts.

The deficiencies concerning TPS documentation (TPD) have been stressed in the Marcy Report. The Marcy Report details the interrelationship of the TPS data to the entire ATE system, and furthermore stresses the impact on the total readiness posture of the Fleet.

5.3.4.2 Analysis. The total system concept must again be applied in terms of the TPS procurement. The hardware procurement cycle must encompass the TPS development process. Data items which define and assist the organizational level test, in terms of the test flow, the summary instructions, the program routine, as well as narratives which provide for anomalies caused by environmental considerations are necessary. In addition, sufficient documentation, such as wiring diagrams and active element schematics for cabling and interconnection devices are necessary.

5.3.4.3 Recommendations. Structuring the TPS data and documentation requirements, in consonance with a total procurement policy, will provide for definition of those items necessary to achieve supportability of the TPS. The TPS in its development will be a marriage of the UUT requirements and the ATE capability, with the attendant documentation providing a road map of test conduct.

The documentation must provide the detailed information necessary to allow a traceable path of the overall test philosophy, the testing paths utilized, program aids as well as the expected results, with exceptions and deviations to the expected norms.

A rigorous prove-out of the TPS documentation is mandatory to ensure that the TPS and its attendant documentation forms a cohesive package.

The Marcy Report established a number of problem areas associated with TPSs. The test program documentation portion of the total problem area may be improved by establishing the following policy:

- a. Require, via policy statements, that project managers for TPS be thoroughly conversant with the documentation requirements of AR-9B. This must include supplementary data.



- b. Establish that TPD be developed in parallel with and as part of the overall TPS program.
- c. Establish a policy which requires that a rigorous prove-out of the TPD be accomplished during the TPS verification utilizing non-engineering personnel.
- d. Within these policies, require that the minimum quality standards recommended in 5.3.2.3 for drawing and data preparation be imposed for the TPD.
- e. Establish a policy which directs that the TPD delivery be concurrent with delivery of the TPS.

#### 5.4 Integrated logistics support impact on automatic test equipment.

5.4.1 Background. Sparing, training, and skill level requirements have been determined in the past by a combination of methods that include contractor recommendation, and review of 3M data and unsatisfactory reports by specialist organizations in the Navy. Trade-offs conducted by ILS personnel included parameters such as cost, maintenance concept, BIT/ATE relationships, location of the ATE (IMA, depot or both), repair/discard philosophies, and the sparing engendered by these parameters. Trade-offs did not always take into account fault isolation ambiguity group sizes, and the ATE/BIT complementary capabilities. Support for automatic testing has had its problems in part, due to the limitations of these methods, and to a large measure, funding and ship space constraints. The result has been increased turnaround time for repairables.

Because of these complex relationships, some tool is required to allow an objective trade-off to be conducted between all these parameters. The objective should be to arrive at a well justified mix between ATE and BIT, and the number of spares required for supporting the prime weapon system and the automatic test equipment.

5.4.2 Analysis. Several Navy and DoD instructions were reviewed that apply, even indirectly, to the ILS impact on ATE. The primary documents reviewed were NAVMAT Instruction 4000.20B - Integrated Logistics Support Planning Policy; NAVMAT P4000 - Integrated Logistics Support Implementation Guide for DoD Systems and Equipments; NAVMAT Instruction 4000.29 - Basic Principles of Logistics. Other instructions more directly related to automatic test equipment were reviewed, such as NAVAIR Instruction 4000.2A - Integrated Logistics Support for Aeronautical Systems and Equipment; NAVAIR Instruction 4000.14 - Navy Prepared Logistic Support Plans for Aeronautical Systems and Equipment; NAVAIR Instruction 4000.12 - Integrated Logistic Support Management Organization and Responsibilities; and NAVAIR Instruction 4790.2 - Maintenance and Support Policy Concerning Weapon Avionic Systems Supported by VAST. The following standards were also reviewed for the impact of logistics on automatic test equipment: MIL-STD-1390.1A - Level of Repair Analysis; MIL-STD-1388 - Logistic Support Analysis; AR-60 - Level of Repair for Aeronautical Material; and MIL-STD-1345, Data Measurement in Support of Maintenance, Calibration and Repair of Electronic Equipment.

The Navy has referenced automatic test equipment in their logistics documents, for example, NAVMAT Instruction 4000.20B page 39; NAVAIR Instruction 4790.2-Maintenance and Support Policy Concerning Weapon Avionic Systems Supported by VAST; and NAVAIR Instruction 4000.14 - Navy Prepared Logistic Support Plans for Aeronautical Systems and Equipment, page 7. For the most part, the logistics support documents listed above are concerned with general purpose electronic test equipment, and the impact on logistics analysis. Very few computer programs remain which can trade off parameters for selecting automatic test equipment. As described in NAVMAT Instruction P4000, there are several typical logistics support models that can trade off several ILS parameters. For instance, the OLF program which trades off total logistics cost support equipment by echelon of maintenance, various logistics times, etc., the LORAN evaluates alternative support postures and allows for trade-off evaluation of any two or more ILS parameters including cost support equipment by echelon of maintenance, NOR rates, various logistics times, etc. There are also several complex operational analysis and logistics models that do everything from simulating aircraft operational events to taking into account resource shortages, flying schedules, alert commitments, abort rates, attrition, and related changes in concepts and policies.

The instructions cover a wide gamut of ILS functions. Actually, ILS functions are impacted by a number of other functions which, in themselves, would relate to automatic test equipment. For instance, reliability, maintainability, human factors, safety, standardization, and quality assurance engineering. All of these disciplines impact on ILS as well as automatic test equipment. Other instructions, such as NAVAIR Instruction 4000.12, call for assuring that adequate funds are budgeted and made available for development of ILS in each system or equipment, and require that ILS requirements approved by the logistics manager are included in all purchase requisitions for all systems and equipment, for which the ILS manager has cognizance. Despite these instructions, programs go forward with inadequate sparing and maintenance funding.

Quite recently, the Navy developed a test equipment effectiveness model which trades off various ILS parameters including the selection of different kinds of automatic test equipment, and built-in-test. The TEEM model as noted herein requires further refinement to be fully operational.

Despite the fact that procurement specifications and project managers require ILS budgets involving SRA and WRA modules, test programs and maintenance aids, the funds allocated for these items are often deleted or reduced due to economics made in programs. When a system is delivered to the Fleet, inadequate numbers of spares and test program sets go along with the systems. The problem still exists, even though the systems are bound to perform integrated logistics support analysis of various kinds. Funding constraints cause systems to be fielded that are not supportable. A case in point is the S-3A aircraft which was delivered to the Fleet with a low percentage of the SRA test programs developed, and resulted in incomplete diagnostic and fault isolation capabilities for all avionics on the S-3A supported by the VAST and HATS systems. Despite the fact that the cognizant test program maintenance facility, the Naval Station, Alameda, had requested funds and manpower to develop the remaining test program sets for the S-3A, the system still lacks a complete complement of test programs.

5.4.3 Recommendations. As a result of the TEEM model partially filling a void in the trade-off of ATE augmented by BIT, and the logistics support required for the ATE and the UUTs that the program indicates, a policy should be written around an improved TEEM model invoking its use on all ILS programs that have to do with automatic test equipment. This tool should also be referenced in the acquisition guide for automatic test equipment. For the short term, a NAVMAT Instruction governing maintenance and support policy concerning automatic test equipment should be written around NAVAIR Instruction 4790.2.

The ILS direction currently promulgated possesses the required level of analysis and control to assure the desired program success. The direction and timing of the ILS processes, however, require refinements, re-emphasis, and cross-checks to form a cohesive program. The following recommendations are offered to provide these refinements:

- a. Establish and promulgate, as guidance, an ILS checklist which emphasizes and provides the interrelationship between the prime equipment ILS and the support equipment requirement. The checklist should address specifically, the support considerations which must be established, implemented or reported on prior to submission for DSARC.
- b. Establish a policy which will allow generation of a companion ILS for support equipments. This companion ILS must have funding derived from, but independent of, the prime system procurement budget. Dollar limits will have to be established which will allow a determination to be made on initiation of companion ILS activity.
- c. Establish a policy requiring the prime system TEMP to fully address the support equipment selection/procurement process for both hardware and software elements.
- d. Establish policy which requires that the prime system ILS and companion support system ILS be integrated, analyzed and updated prior to submittal for DSARC. This policy should also direct and establish that the companion ILS be initiated immediately after DSARC I (i.e., during validation phases).

#### 5.5 Contractual requirements for automatic test equipment.

5.5.1 Background. Efforts to procure TPSs by the Navy for specific avionics or equipment would be considerably eased with the development of standard procurement specifications for SRAs and WRAs. These will contain requirements to verify, validate and control configuration of TPSs. These documents will also reference the standard TRD now under development by the Navy which may be in the form of a revised MIL-STD-1519 or AR-8, 9 and 10 documents.



The S-3A avionics test program problems originated when VAST was directed as the primary support equipment. Seventy-five percent of the avionics for the S-3A had already been delivered. The resultant lack of a consistent maintenance philosophy on the avionic black boxes severely complicated the fault isolation capability of VAST. Subcontracts let for S-3A SRAs led subcontractors to believe that they would supply the support equipment for their SRAs. The SRA designs also were based on throw-away concepts rather than fault isolation.

The B-1 program spent many man-hours resulting in a multi-volume procurement specification for their functional test stations. Within this specification was a specification for the B-1 avionics TPSs based on a common test requirements document for all TPSs. Standard data item descriptions have been developed for the B-1 program to provide direction to system designers. The standard DID and CDRL samples are enclosed as Appendix F.

5.5.2 Analysis. Standard DIDs have been available for inclusion in procurement packages that relate to ATE/BIT. DIDs developed for the B-1 and S-3 programs have been analyzed but most are general in nature and do not solve problems in validation, verification, configuration control, standardization, testability and other important testing problems. There were DIDs which did address these areas, and these are meaningful in terms of overall program performance.

By specifying certain trade-off study results as deliverables, the DIDs provide an assurance that testability and ATE/BIT considerations are integrated into the design from inception. In the past, these studies were required by the Navy but did not require that the data be delivered. Contractors were only obligated to show results and thus did not include detailed analysis which explained how they arrived at the results. A contractor, knowing that his analysis will now be subject to careful scrutiny and approval, will be more diligent in developing effective, early-on design decisions with regard to testability, supportability and cost.

5.5.3 Recommendations. It is recommended that a NAVMAT Instruction containing standard ATE-related DIDs be issued. It is also recommended that a policy be promulgated requiring DIDs for ATE selection and instability, etc., be generated.

## 5.6 Configuration control and ATE.

5.6.1 Background. UUT test programs must be developed so that a minimum number of interface devices (IDs) are required. However, once developed and accepted, changes to any part of this test program set, which includes the UUT, ATE, TRD and test program, must be controlled - that is, the configuration design must be controlled. A chain of problems occurs when the ATE manufacturer, ID designer, white-hat or avionics manufacturer makes a modification to the test program, or design of the UUT, and none of these engineering activities notifies the other. What results is a chain of developments that is impossible to trouble-shoot. The problem is compounded by the use of contractors to develop test programs or make engineering changes without regard to those systems already in the Fleet, and without regard to the impact on other elements, including the interface devices. For example, a contractor developing a test program for the S-3 avionics may develop a test program without testing it with the interface device available with the HATS system. The test program

set sent to the aircraft carrier intended to use the system has a different version of the HATS and a different version of the interface device, and possibly a different version of the UUT meant to be tested. Multiply this problem by the number of prime weapons systems designed to be supported by automatic test equipment, and configuration control and management of test program sets becomes critical.

While the Navy has many documents that address themselves to configuration management and control, few of these documents specifically address the problem associated with test program sets. The section that follows is designed to analyze what instructions and standards exist that can be used to address the problem of TPS configuration control and management.

5.6.2 Analysis. A handful of instructions exist that address the problem of configuration management of hardware/software. Among these are the NAVMAT Instruction 4130.1A - Department of Defense Configuration Management Manual; MIL-STD-480 - Configuration Control Engineering Changes, Deviations and Waivers; MIL-STD-481 - Configuration Control Engineering Changes (Short Form); NAVAIR Instruction 4130.1, Changes 1, 5 and 8 - NAVAIRSYSCOM Configuration Management Manual; NAVAIR Instruction 4275.3B - Configuration Control, MIL-STD-480 and 481, Implementation of; AR-9B - Test Program Sets, General Requirements for; and MIL-STD-1519 - TRD, Preparation of.

Currently, AR-9B and MIL-STD-1519 are being rewritten to develop a new test requirements document military standard. Although all the above references are broad enough to cover the subject at hand, that is, they require change board approval of any changes to hardware or software or the interface device, none of these are specific enough to address the test program set problem as a total system. A part of one instruction approaches the test program set configuration control problem: NAVAIR Instruction 4130.1 Appendix C (Configuration Management for VAST). However, this instruction is written around the VAST test stations. It does, however, correct an earlier deficiency wherein the organizations responsible for test program set development are made voting members of the change control board. The instructions must also be rewritten to a point of view of designating specific support facilities for other automatic test equipments, or developing the general criteria for designating these facilities. NAVAIR Instruction 4275.3B requires that procurement documents for the acquisition of NAVAIR material contain a configuration control clause invoking either MIL-STD-480 or 481 depending on the item being procured.

Various components of configuration management can be found in different instructions and standards. For example, several definitions exist for Class I and Class II engineering changes. MIL-STD-480 defines a Class I engineering change which contains one or more of a number of factors. One of the factors being an effect on the interface characteristics which can be interpreted as changes in test programs affecting the interface device between the UUT and the ATE. This paragraph is referenced in NAVMAT Instruction 4130.1A. AR-8B VAST Avionic Systems Compatibility, General Requirements for, also references MIL-STD-480 in defining Class I engineering changes. Paragraph 4.1.3 of AR-8B defines configuration control requirements of TRDs. In general, one must search several documents to arrive at an overall configuration management procedure for ATE.

5.6.3 Recommendations. It is recommended that a NAVMAT Instruction be developed which is written around the combination of MIL-STD-480, 481, and NAVAIR Instruction 4130.1, Appendix C. This would be a short term recommendation, and minor changes to NAVAIR Instruction 4120.1 Appendix C would be the basis for this instruction. For the long term, an addition of a section to MIL-STD-480 that covers test program set configuration management is recommended.



APPENDIX A

NAVMAT ATE RELATED  
INSTRUCTION SUMMARY

## APPENDIX A

Details of the review of all NAVMAT instructions are contained in this appendix. The instructions were categorized into 9 elements: Acquisition and Planning; Software and Configuration Management; Maintenance; Logistics; Personnel and Training; Finance; Safety, RM and QA; ATE and Calibration; and Standardization. Only those instructions directly related to test and monitoring systems were reviewed. Each instruction was synopsisized and recommendations made to make it suitable for ATE considerations. Although there were no voids in any of the categories, many of the instructions were unsuitable for revision to cover certain ATE aspects. As a result of this review, the six categories listed in the report summary were chosen as recommended new policies and procedures to fill voids.

TABLE A-1. NAVMAT DIRECTIVES - INSTRUCTIONS

I. ACQUISITION & PLANNING	II. SOFTWARE & CONF. MGMT.	III. MAINTENANCE	IV. LOGISTICS	V. PERSONNEL & TRAINING	VI. FINANCE	VII. SAFETY RM & QA	VIII. ATE & CALIB.	IX. STANDARD- IZATION
3910.5C 3910.7B 3960.6A 3960.9	4120.105 4130.1A 5050.11 5200.35A	4700.11A 4790.16 4790.17 4856.1	4000.20B 5600.15D	1500.2C 4490.1B	4340.5A 7000.19	5420.41	3960.4A 3960.9 4120.105 4440.46 5230.8 5420.44B	4120.101A



TABLE A-2. NAVMAT INSTRUCTIONS ACQUISITION AND PLANNING

NO.	CAT.	DATE	TITLE	CONTENT	COMMENT	REFERENCE
3960.9	1	SEP 76	ACQUISITION PLANNING GUIDE FOR AUTOMATIC TEST MONITORING & DIAGNOSTIC SYSTEMS & EQUIPMENT BUILT-IN-TEST (BIT) DESIGN GUIDE, PROMULGATION OF	AIDS PM'S IN OPTIMIZING ACQUISITION & DEVELOPMENT OF SUPPORT AND ATE INCLUDES THE TWO NEW GUIDES (ATE ACQUISITION GUIDE & BIT GUIDE)	THIS IS A NEW DOCUMENT	NAVMAT INSTR 3960.4A, 4000.20B
3910.5C	1	MAY 71	TDP'S & R&D PLANNING SUMMARIES (DD1634'S) PROCEDURES FOR PREPARATION, SUBMISSION & DISTRIBUTION OF	COVERS FORMAT & CONTENT OF FORMS 1634, 3910-3, 3910-7 & INCLUDES REQTS FOR TESTABILITY, FINANCIAL REQTS & WBS AND THE COMPLETION OF THE OVER 70 DIRECTIVES	REVIEW ALL REFERENCES FOR OVERLAP, REDUNDANCY, ETC. UPDATE TESTABILITY REQTS. REARRANGE TO FACILITATE USE. ATE QUESTIONS ON PAGE 3-3 ARE OBSOLETE.	DODINST 7720.16 OPNAVINST 3910.4D, 3910.16B SECNAVINST 3900.32A ONRINST 3900.24A, 3910.5 NAVMATINST 3910.7A, 5400.10
3910.7B	2	JAN 69 NOV 71 CHANGE NO. 2	PLANNING PROCEDURES FOR THE DEPT. OF THE NAVY EXPLORATORY DEVELOPMENT PROCEDURE	TASK AREA PLAN (TAP) USE & REQTS. NAVMAT FORM 3910/1 FUNDING PROFILE & 1634'S CHIEF OF NAVAL DEVELOPMENT PROGRAM COORDINATION BY CND	ENCL. (2), PAGE 2, SEC.3.b, ADD TO FIRST PARAGRAPH: "... SPECIAL BLOCK NO. 12. SPECIAL ATTENTION SHOULD BE GIVEN TO THE NEED FOR AUTOMATIC TEST EQUIPMENT, BUILT-IN-TEST (ON-LINE AND OFF-LINE), WITH PARTICULAR EMPHASIS ON EXISTING AND AVAILABLE EQUIPMENT OR REQUIRED MODIFICATIONS THERETO".	SECNAVINST 5430.67 OPNAVINST 3900.8C NAVMATINST 3910.12A, 3910.10A
3960.6A	2	AUG 73	PLANNING & IMPLEMENTATION OF TESTS & EVALUATIONS OF NEW WEAPONS SYSTEMS	REQUIRES PROGRESSIVE ACHIEVEMENT OF MILESTONES (PERFORMANCE, COSTS & SCHEDULES) DESCRIBES THE TEMP FORMAT & CONTENT, & PROJECT MANAGERS' & COMMANDS RESPONSIBILITIES	REVISION MAY INCLUDE SUPPORTABILITY	DOD DIRECTIVE 5000.1 DOD DIRECTIVE 5000.3 SECNAVINST 5000.1 OPNAVINST 3960.8 OPNAVINST 3960.9A OPNAVINST 3930.8B NAVMATNOTE 3960

TABLE A-3. NAVMAT INSTRUCTIONS  
SOFTWARE AND  
CONFIGURATION MANAGEMENT

NO.	CAT.	DATE	TITLE	CONTENT	COMMENT	REFERENCE
4120.105	1	MAR 75	ATE PROGRAMMING LANGUAGE INTERIM STD FOR	CALLS FOR ATLAS AS THE STANDARD PRO- GRAMMING LANGUAGE.		
4130.1A	2	JUL 74	CONFIGURATION MANAGEMENT	GENERALIZED DOCU- MENT ON CONFIGURA- TION MANAGEMENT	NEED CONFIGURATION MANAGEMENT OF TEST PROGRAM SETS	
5050.11	2	MAR 72	EXCHANGE OF INFOR- MATION	ENCOURAGES INFOR- MATION EXCHANGE BETWEEN NAVMAT, SYSCOM'S & PM'S - ONE PAGE MEMO	POSSIBLE USE FOR ATE DATA BANK	NONE
5200.35A	1	JUN 75	GIDEP: PARTICIPATION IN	SETS POLICY FOR OPERATIONS CENTER, POLICY BOARD, REP. REPRESENTATIVES	ADD PARAGRAPH 7.f "ESTABLISH CONTROLS TO INSURE THAT ALL DATA RELATING TO AUTOMATIC TEST EQUIPMENT (ATE) REGARDING DESCRIP- TION, FUNCTION, LOCA- TION, AVAILABILITY AND DISPOSITION IS SUBMITTED TO FMSAEG FOR INCORPORATION INTO THE ATE DATA BANK(S)."	MIL-STD 1556

TABLE A-4. NAVMAT INSTRUCTIONS  
MAINTENANCE

NO.	CAT.	DATE	TITLE	CONTENT	COMMENT	REFERENCE
4700.11A	2	APR 69	TECHNICAL/MAINTENANCE OVERHAUL & REPAIR STANDARDS	LISTS PRECEPTS FOR MAINTENANCE, OVERHAUL & REPAIR STANDARDS INCLUDING REQUIREMENTS FOR INSPECTION & REVIEW, TESTING FOR SUITABILITY, TEST EQUIPMENT, FACILITIES, ETC.	POSSIBLE CANDIDATE FOR REVISION TO INCLUDE ATE & TPS PRECEPTS	NAVMATINST 4700.4
4790.16	3	OCT 72	DOD EQUIPMENT MAINTENANCE PROGRAM	POLICY COVERS COLLECTION OF WORK FOR FORCE DATA, MAINTENANCE PROGRAM ESTABLISHMENT TECH DATA, COSTS, STANDARDIZATION OF TEST EQUIPMENT, ETC.	NO REVISION REQUIRED	DOD DIRECTIVE 4151.1
4790.17	2	DEC 72	FEEDBACK RESPONSE FOR CASREPT AND NORS DATA; POLICY & RESPONSIBILITIES FOR	POLICY & RESPONSIBILITY FOR EACH SYSTEM TO REVIEW CASREPT & NORS DATA TO IDENTIFY EQUIPMENT PROBLEMS & TO TAKE CORRECTIVE ACTION	DIRECTS COMMANDER, NAVAL SUPPLY SYSTEMS COMMAND TO PROVIDE A LIST OF EQUIPMENTS PERIODICALLY TO EACH SYSTEM IDENTIFYING SUPPORT PROBLEMS. POSSIBLE ATE PROBLEM FLAG	FASO INST 5442.16 NAVMATINST 4000.23 NAVMATINST 4790.10 OPNAVINST 4700.19D
4856.1	3	OCT 66	IMPROVED MAINTENANCE SUPPORT	CALLS FOR ANNUAL PRESENTATION BY 3 ORGANIZATIONAL LEVELS OF IMPORTANT ACHIEVEMENTS & ADVANCES IN TOOLS, TECHNIQUES, PRACTICES & PROCEDURES	NO REVISION REQUIRED BUT ATE PROGRAM SHOULD HAVE BEEN PRESENTED TO THE DCNM	NAVMATINST 4700.4



TABLE A-5. NAVMAT INSTRUCTIONS  
PERSONNEL AND TRAINING

NO.	CAT.	DATE	TITLE	CONTENT	COMMENT	REFERENCE
4000.20B	2	JAN 76	INTEGRATED LOGISTICS SUPPORT PLANNING POLICY	PROVIDES COMPLETE ILS MANUAL	NEWLY REVISED (IV. LOGISTICS)	SECNAVINST 4000.29A OPNAVINST 4100.3 (JAN 71)
5600.15D	1	OCT 74	NMC POINTS OF CONTACT FOR SHIPBOARD EQUIPMENT	LISTS EQUIPMENT AND CODES & PHONE NUMBERS AS POINTS OF CONTACT FOR MAINTENANCE & OPERATION TECHNICAL INFORMATION	THIS VERSION NOT AVAILABLE. SHOULD CHECK ON CODES & PHONE NUMBER ACCURACY (IV. LOGISTICS)	NONE
1500.2C	3	APR 75	PREPARATION & IMPLEMENTATION OF NAVY TRAINING PLANS FOR NEW DEVELOPMENTS	ASSIGN ACTIONS & GUIDANCE TO SYSCOMS & PM'S TO COORDINATE, PLAN & IMPLEMENT TRAINING & PERSONNEL PROGRAMS	C VERSION NOT AVAILABLE (V. PERSONNEL & TRAINING)	NAVMATINST 4000.20 OPNAVINST 1500.8G OPNAVINST 1500.11F
4490.1B	1	JUL 72	AVAILABILITY OF EQUIPMENT FOR TRAINING PURPOSES	CONCERNS ACTION, PROCEDURES AND RESPONSIBILITY TO MAKE EQUIPMENT AVAILABLE FOR TRAINING	REVISION REQUIRED TO COVER ATE (V. PERSONNEL & TRAINING)	OPNAVINST 4490.2B

TABLE A-6. NAVMAT INSTRUCTIONS  
FINANCE

NO.	CAT.	DATE	TITLE	CONTENT	COMMENT	REFERENCE
4340.5A	3	AUG 73	PROPERTY CONTROL FOR SPECIAL TOOLING & SPECIAL TEST EQUIP- MENT LOCATED AT NAVAL SHORE (FIELD) ACTIVITY UNDER COMMAND OF CNM, POLICY & PROCEDURES FOR	SPECIAL TOOLING & STE AT CONTRACTORS PLANTS & FIELD ACTIVITIES. REQUIRE- MENTS FOR CONTROL & INVENTORY OF SPECIAL TEST EQUIP- MENT	PHYSICAL INVENTORY REVISION EVERY 3 YEARS PAGE 2, SEC 6.a, ADD A NEW PARA.: "COPIES OF THE PHYSICAL INVENTORY REPORTS AND THE QUARTERLY OR SEMI-ANNUAL UPDATES SHALL BE FORWARDED TO FMSAEG FOR INCLU- SION IN THE DATA BANK(S) FOR ATE."	NAVCOMPT MANUAL VOL. 3, CHAPT. 6 PART D.
7000.19	3	FEB 73	COST ANALYSIS PRO- GRAM	IMPLEMENTS OPNAV- INST 7000.17 WHICH DETAILS COST ESTI- MATING RESPONSI- BILITIES, POLICIES, DOCUMENTATION & FORMATS. OPNAV FORM 7000/2 ASSIGNED AS REPORTING REQUIREMENT	SHOULD INCLUDE ATE COST ESTIMATION FORMAT/CRITERIA	OPNAVINST 7000.17

TABLE A-7. NAVMAT INSTRUCTIONS  
R&M AND QA

NO.	CAT.	DATE	TITLE	CONTENT	COMMENT	REFERENCE
5420.41	2	MAR 73	MANAGEMENT OF SHIP FIRE PROTECTION & DAMAGE CONTROL PROGRAMS IN NMC	ESTABLISHES ACTION GROUP. NAVSHIPS ASSIGNED RESPONSIB- ILITY (SECRETARIATE & ADMINISTRATIVE SUPPORT) SPECIAL ASSISTANT TO CNM IS NAVMAT FOCAL POINT	NEEDS COVERAGE WITH ORMS	NAVMATINST 5420.41



TABLE A-8. NAVMAT INSTRUCTIONS  
ATE AND CALIBRATION

NO.	CAT.	DATE	TITLE	CONTENT	COMMENT	REFERENCE
3960.4A	1	DEC 73	POLICY & RESPONSIBILITY FOR AUTOMATIC TEST, MONITORING & DIAGNOSTIC SYSTEMS & EQUIP. IMPLEMENTATION OF	DEFINES RESPONSIBILITIES OF CNM, SYSTEMS, PROJECT OFFICES, SUPPORT ACTIVITIES WITH REGARD TO ATE & APPLICABLE POLICIES	NO REVISION NECESSARY	SECNAVINST 3960.4 SECNAVINST 5000.1 NAVMATINST 4000.20A NAVMATINST 4120.97A NAVMATINST 5300.9A MIL-STD 1309A
3960.9			SEE CATEGORY I (ACQUISITION & PLANNING)			
4120.105	1	MAR 75	ATE PROGRAMMING LANGUAGE, INTERIM STD. FOR	CALLS FOR ATLAS AS INTERIM STANDARD TEST PROGRAMMING LANGUAGE	NEEDS UPDATE TO SPECIFY ATLAS AS STANDARD NAVY TEST PROGRAMMING LANGUAGE	
4440.46	1	DEC 74	INVENTORY OF AUTOMATIC TEST MONITORING & DIAGNOSTIC SYSTEMS & EQUIPMENT, REQUEST FOR	CALLS FOR INVENTORING ATE IN NAVY	WHAT HAS BEEN DONE WITH RESULTS OF INVENTORY ?	
5230.8	1	NOV 74	DATA BANKS FOR ATMDs & EQUIPMENT, UTILIZATION OF	IDENTIFIES 3 DATA BANKS FOR ATE INFORMATION	NEEDS TO BE EXPANDED WITH LOGISTICS MODELS, INVENTORY INFORMATION, ETC.	
5420.44B	3	JUN 75	TEST MEASURING & DIAGNOSTIC EQUIPMENT (TMDE) ACTION GROUP		REFERENCES ATE BUT IS REALLY A CALIBRATION AND GPETE DOCUMENT	

TABLE A-9. NAVMAT INSTRUCTIONS  
STANDARDIZATION

NO.	CAT.	DATE	TITLE	CONTENT	COMMENT	REFERENCE
4120.101A	1	APR 71	INTERFACE STANDARDS FOR SHIPBOARD SYSTEMS, IMPLEMENTATION OF	CALLS FOR CONTINUED DEVELOPMENT & UTILIZATION OF MIL-STD 1399	POSSIBLE REVISION IN RELATION TO MIL-STD 1326. WHAT IS STATUS OF MIL-STD 1399 ? HOW DOES IT AGREE WITH 1326B ?	

APPENDIX B

DoD TEST AND MONITORING SYSTEMS  
POLICIES AND PROCEDURES



## APPENDIX B

This appendix contains a listing of ATE related DoD, Air Force, Army, OPNAV, NAVAIR and NAVELEX instructions. The technical discussion in Section 5 of this report revolves around many of these instructions.

**TABLE B-1. DOD INSTRUCTIONS**

<b>INSTRUCTION NUMBER</b>	<b>DATE</b>	<b>TITLE</b>	<b>CATEGORY</b>
<b>4100.35</b>	<b>OCT 1970</b>	<b>DEVELOPMENT OF ILS FOR SYS- TEMS/EQUIPMENTS (I&amp;L)</b>	<b>LOGISTICS</b>
<b>5000.29</b>	<b>APR 1976</b>	<b>MANAGEMENT OF COMPUTER RE- SOURCES IN MAJOR DEFENSE SYS- TEMS I&amp;L</b>	<b>SOFTWARE &amp; CONFIGURA- TION MANAGEMENT</b>
<b>5010.19</b>	<b>JUL 1968</b>	<b>CONFIGURATION MANAGEMENT (DDR&amp;E)</b>	<b>SOFTWARE &amp; CONFIGURA- TION MANAGEMENT</b>
<b>5010.21</b>	<b>AUG 1968</b>	<b>CONFIGURATION MANAGEMENT IMPLEMENTATION GUIDANCE (DDR&amp;E)</b>	<b>SOFTWARE &amp; CONFIGURA- TION MANAGEMENT</b>
<b>5126.43</b>	<b>MAR 1970</b>	<b>DOD LOGISTICS SYSTEMS PLANNING (I&amp;L)</b>	<b>LOGISTICS</b>

TABLE B-2. AIR FORCE & U.S. ARMY

INSTRUCTION NUMBER	DATE	TITLE	CATEGORY
AIR FORCE LOGISTICS COMMAND VOL. I SUPP. NO. 1 AFR 800-14	15 OCT 1976	MANAGEMENT OF COMPUTER RESOURCES IN SYSTEMS	SOFTWARE & CONFIGU- RATION MANAGEMENT
AIR FORCE LOGISTICS COMMAND VOL. II SUPP. NO. 2 AFR 800-14	18 OCT 1976	ACQUISITION & SUPPORT PROCEDURES FOR COMPUTER RESOURCES IN SYSTEMS	SOFTWARE & CONFIGU- RATION MANAGEMENT
AIR FORCE LOGISTICS COMMAND REG. NO. 66-37	15 MAR 1976	MANAGEMENT OF AUTOMATED TEST SYSTEMS	ATE & CALIBRATION
U.S. ARMY		TWENTY COMMANDMENTS OF SOFTWARE ACQUISITION	SOFTWARE & CONFIGU- RATION MANAGEMENT



TABLE B-3. OPNAVINST

INSTRUCTION NUMBER	DATE	TITLE	CATEGORY
3960.11	MAR 1976	AUTOMATIC TEST MONITORING & DIAGNOSTIC SYSTEMS & NEW EQUIPMENTS	ATE & CALIBRATION
4100.3A	NOV 1972	DEPARTMENT OF NAVY ILS SYSTEM	LOGISTICS
4700.24 CH. 1	JUN 1968 FEB 1970	POLICIES GOVERNING MAINTENANCE ENGINEERING WITHIN DOD	MAINTENANCE
4700.26	JAN 1970	MAINTENANCE MANAGEMENT OBJECTIVES, RESPONSIBILITIES FOR REPORTING OF	MAINTENANCE
4790.2A CH. 1 VOL. I	JUN 1973	NAVAL AVIATION MAINTENANCE PROGRAM	MAINTENANCE

TABLE B-4. NAVAIRINST

INSTRUCTION NUMBER	DATE	TITLE	CATEGORY
1500.2A	NOV 1975	TRAINING FOR MILITARY PERSONNEL WITHIN NAVAIR REWORK FACILITIES, POLICY & PROCEDURE FOR	PERSONNEL & TRAINING
4000.2C	JUN 1976	ILS FOR AERONAUTICAL SYSTEMS & EQUIPMENT	LOGISTICS
4000.10A	JUN 1973	REQUIREMENT FOR USE OF DOD GUIDE 4100.35G OF 15 OCT 1968, ILS PLANNING GUIDE FOR DOD SYSTEMS & EQUIPMENT	LOGISTICS
4000.12	OCT 1973 (REV.)	ILS MANAGEMENT ORGANIZATION & RESPONSIBILITIES	LOGISTICS
4000.14A	JUN 1975	NAVY PREPARED ILSPS & OLSPS FOR AERONAUTICAL SYSTEMS & EQUIP- MENT	LOGISTICS
4130.1	SEP 1970	CONFIGURATION MANAGEMENT MANUAL	SOFTWARE & CONFIGUR- ATION MANAGEMENT
4275.3B	OCT 1969	CONFIGURATION CONTROL	SOFTWARE & CONFIGUR- ATION MANAGEMENT
4330.8A	FEB 1976	RESPONSIBILITIES & PROCEDURES FOR ACQUISITION, USE & DISPOS- ITION OF SPECIAL TOOLING & STE ACCOUNTABLE UNDER NAVAIR SUP- PLY & SERVICES CONTRACTS	ACQUISITION & PLANNING
4411.1	APR 1971	PROCEDURES FOR IMPLEMENTATION OF THE COMMON GSE RETIREMENT PROGRAM	ACQUISITION & PLANNING
4440.9A	AUG 1975	REQUEST FOR INVENTORY OF ATE	ATE & CALIBRATION
4441.2	DEC 1972	INVENTORY/IN-USE MANAGEMENT OF AN/USM 247(V) VAST ASSOCIATED GSE APPEARING IN THE QV-1 & QV-2 ALLOWANCE LISTS	ATE & CALIBRATION
4700.6A	SEP 1971	PLANNING, PROGRAMMING, BUDGET- ING, PROCUREMENT & ILS OF CGSE END ARTICLES; PROCEDURES & RESPONSIBILITY FOR	LOGISTICS
	JAN 1976	GSE LOGISTICS DIVISION	LOGISTICS

TABLE B-4. NAVAIRINST (Cont'd)

INSTRUCTION NUMBER	DATE	TITLE	CATEGORY
4700.17	JUN 1974	POLICIES GOVERNING MAINTENANCE ENGINEERING WITHIN NAVAIR- SYSCOM	MAINTENANCE
4720.4	MAR 1976	IN SERVICE ENGINEERING PROGRAM FOR ATE TEST PROGRAMS	ATE & CALIBRATION
4790.2	FEB 1973	MAINTENANCE & SUPPORT POLICY CONCERNING WEAPON/AVIONIC SYSTEMS SUPPORTED BY VAST (AN/USM-247(V))	ATE & CALIBRATION
5400.18	OCT 1969 (REV.)	ESTABLISHMENT OF PROGRAM MANAGER FOR GROUND SUPPORT EQUIPMENT	ACQUISITION & PLANNING
5400.67	MAR 1972	CERTIFICATION PROGRAM FOR NAVY AIR-LAUNCHED GUIDED WEAPON TEST SYSTEM	ATE & CALIBRATION
5400.72	JUN 1973	POLICY & RESPONSIBILITY FOR THE SELECTION, DESIGN, APPROVAL, ORDERING, DELIVERY & LOGISTICS SUPPORT OF GSE	ACQUISITION & PLANNING
13800.4	JUL 1968	GSE FOR WEAPONS SYSTEMS UNDER AUGMENTED SUPPORT; PROCEDURES & RESPONSIBILITIES FOR	MAINTENANCE
AR8B	24 DEC 1974	VAST/AVIONICS SYSTEM COMPATI- BILITY, GENERAL REQUIREMENTS FOR	ATE & CALIBRATION
AR9B		VAST TEST PROGRAMS, GENERAL REQUIREMENTS FOR	ATE & CALIBRATION
AR10A	16 JUN 1969 NOTICE 1	MAINTAINABILITY OF AVIONICS EQUIPMENT & SYSTEMS, GENERAL REQUIREMENTS FOR	ATE & CALIBRATION
AR30A		ILS REQUIREMENTS FOR AS & EQUIP- MENTS	ATE & CALIBRATION

TABLE B-5. NAVELEXINST

INSTRUCTION NUMBER	DATE	TITLE	CATEGORY
4200.8B	FEB 1972	ACQUISITION PROCEDURES FOR PRODUCTION HARDWARE	ACQUISITION & PLANNING



APPENDIX C

ATE RELATED DOCUMENTS

## APPENDIX C

This appendix contains ATE related military specifications. These specifications are illustrated in Figure C-1. This appendix also provides, in matrix format, items which define the BIT/test point/interface bus specifications, and provides content and commentary for each document.

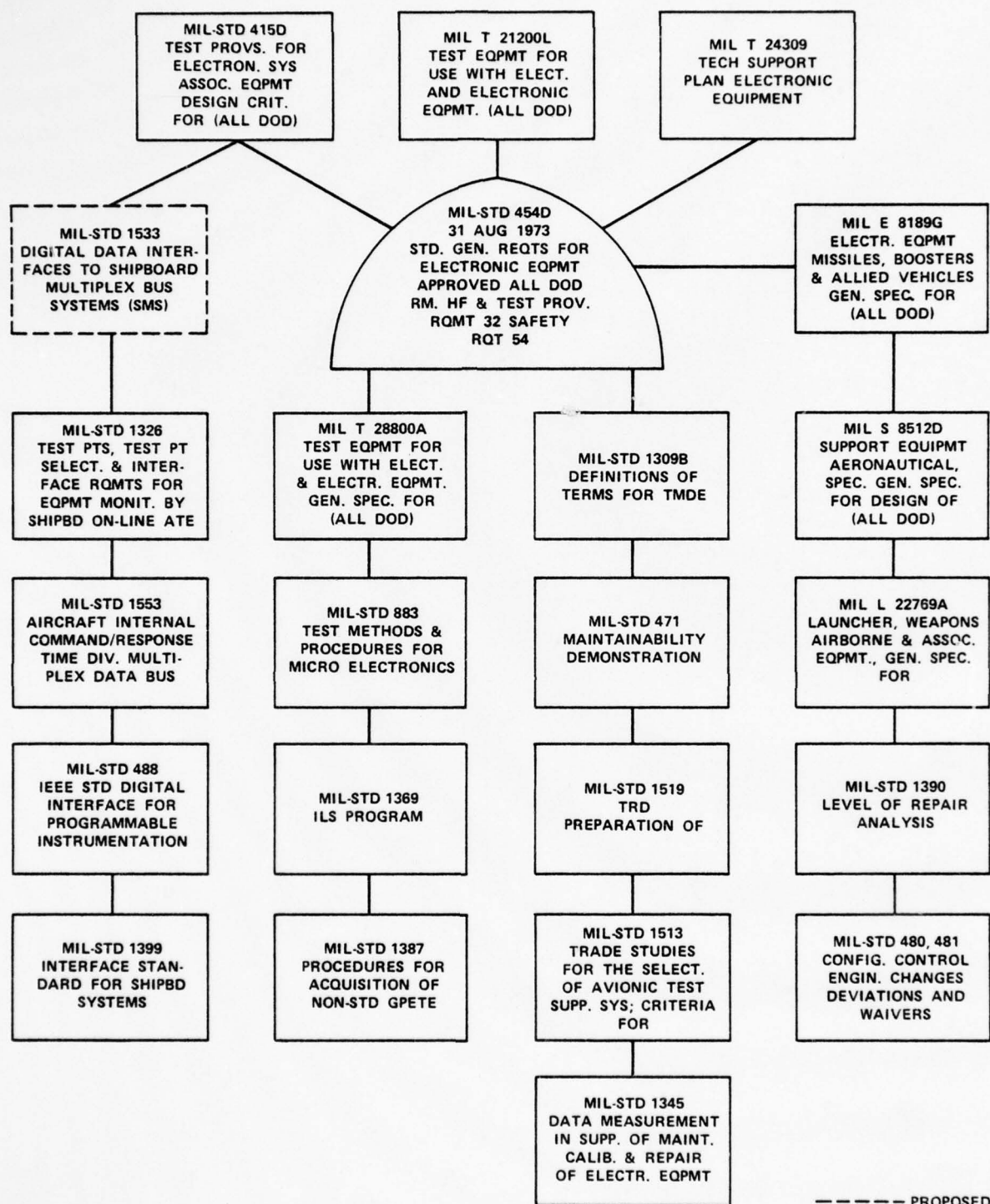


Figure C-1. ATE-Related Military Standards.

TABLE C-1. ATE-RELATED MILITARY STANDARDS

MIL-S-8512D	SUPPORT EQUIPMENT, AERONAUTICAL, SPECIAL. GEN. SPEC FOR DESIGN OF
MIL-T-21200L	TEST EQUIPMENT FOR USE WITH ELECTRICAL & ELECTRONIC EQUIPMENT, GEN. SPEC. FOR
MIL-T-21578A	TEST EQUIPMENT, HAZARDOUS LOCATION, INSTALLED, BASIC RQMTS FOR
MIL-T-24309 (SHIPS)	TECH. SUPPORT PLAN - ELECTRONIC EQUIPMENT
MIL-T-28800A	TEST EQUIPMENT FOR USE WITH ELECTRICAL AND ELECTRONIC EQUIP- MENT. GEN. SPEC. FOR
MIL-W-7622B	WEAPON SYSTEMS, GUIDED MISSILES, GEN. SPEC. FOR
MIL-STD-1309B	DEFINITIONS OF TERMS FOR TEST, MEASUREMENT & DIAGNOSTIC EQUIP- MENT
MIL-STD-287	TEST SIGNALS FOR ELECTRONIC TACTICAL AIR NAVIGATION EQUIPMENT
MIL-M-9901A (USAF)	TECHNICAL MANUAL, TAPES, CARDS
MIL-STD-480	CONFIGURATION CONTROL - ENGINEERING CHANGES, DEVIATIONS AND WAIVERS
MIL-STD-482	CONFIGURATION STATUS ACCOUNTING DATA ELEMENTS AND RELATED FEATURES
MIL-P-15137C (SHIPS)	PROVISIONING TECHNICAL DOCUMENTATION
MIL-HDBK-472	MAINTAINABILITY PREDICTION
MIL-P-24052	TEST PROCEDURES RADIAC INSTRUMENTS
MIL-S-24277 (SHIPS)	STANDARDIZATION PROGRAM
AD-837694	A GUIDE TO THE APPLICATION OF BIT TO NAVY AVIONIC EQUIPMENT



TABLE C-2. MAJOR BIT/TEST POINT/INTERFACE BUS RELATED DOCUMENT SUMMARY

DOCUMENT	NAME	SCOPE	CONTENTS	NOTES
MIL-STD-454	STANDARD GENERAL REQUIREMENTS FOR ELECTRONIC EQUIPMENT.	ESTABLISHES COMMON REQUIREMENTS FOR ALL DOD ELECTRONIC EQUIPMENT.	REQUIREMENT 32 (TEST PROVISIONS) SPECIFIES THAT TEST PROVISIONS SHALL BE PROVIDED PER MIL-STD-415.	PARAGRAPHS 3.1 (BUILT-IN-TEST DEVICES) AND 3.2 (EXTERNAL TEST POINTS) ARE REDUNDANT IN THAT MIL-STD-415 SPECIFIES REQUIREMENTS FOR THESE PROVISIONS.
MIL-STD-415	TEST PROVISIONS FOR ELECTRONIC SYSTEMS AND ASSOCIATED EQUIPMENT, DESIGN CRITERIA FOR.	ESTABLISHES DESIGN CRITERIA FOR TEST PROVISIONS THAT PERMIT THE PARAMETERS OF ELECTRONIC SYSTEMS AND ASSOCIATED EQUIPMENT TO BE MONITORED, EVALUATED, OR ISOLATED.	SPECIFIES GENERAL DESIGN CONSIDERATIONS FOR: <ul style="list-style-type: none"> <li>• BIT CAPABILITY REQUIREMENTS.</li> <li>• TEST POINT CAPABILITY REQUIREMENTS.</li> <li>• AUTOMATIC CHECKOUT EQUIPMENT (ACE) AND AUTOMATIC MONITORING EQUIPMENT (AME) (i.e., ORMS) CAPABILITY REQUIREMENTS.</li> </ul>	THE PURPOSE OF THE STANDARD IS TO PROVIDE TEST PROVISIONS THAT WILL ADEQUATELY SUPPORT A DEFINED MAINTENANCE CONCEPT. THE STANDARD STATES THAT TEST POINTS SHALL BE PROVIDED FOR ITEM PARAMETERS AND CHARACTERISTICS WHICH REQUIRE TESTING AND ARE NOT TESTED BY ACE/AME AND BIT.
MIL-STD-1553A	AIRCRAFT INTERNAL TIME DIVISION COMMAND/RESPONSE MULTIPLEX DATA BUS.	THE SPECIFICATION DEFINES THE REQUIREMENTS FOR DIGITAL, COMMAND/RESPONSE, TIME DIVISION MULTIPLEXING (DATA BUS) TECHNIQUES ON AIRCRAFT.	THE SPECIFICATION DETAILS THE REQUIREMENTS/CHARACTERISTICS DATA BUS AND ITS ASSOCIATED INTERFACE ELECTRONICS AS WELL AS THE OPERATION AND INFORMATION FLOW ON THE BUS AND THE ELECTRICAL AND FUNCTIONAL FORMATS EMPLOYED.	THE PURPOSE OF THIS DOCUMENT IS TO ESTABLISH UNIFORM REQUIREMENTS FOR MULTIPLEX DATA SYSTEMS FOR AIRCRAFT AND TO PROMOTE STANDARD DIGITAL INTERFACES FOR THEIR ASSOCIATED SUBSYSTEMS.

TABLE C-2. MAJOR BIT/TEST POINT/INTERFACE BUS RELATED DOCUMENT SUMMARY (Cont'd)

DOCUMENT	NAME	SCOPE	CONTENTS	NOTES
NAVAIR AR-8	VERSATILE AVIONIC SHIP TEST SYSTEM/ AVIONICS SYSTEMS COMPATIBILITY, GENERAL REQUIRE- MENTS FOR.	SPECIFICATION DE- TAILS THE REQUIRE- MENTS FOR DESIGN FEATURES WHICH MUST BE INCORPO- RATED INTO AVIONIC SYSTEMS SO THAT THEY MAY BE COM- PATIBLE WITH THE VAST SYSTEM.	<ul style="list-style-type: none"> <li>DEFINES VAST (i.e., TEST SYSTEM) COMPATIBILITY RE-QUIREMENTS IN TERMS OF THE FOLLOWING: <ul style="list-style-type: none"> <li>UUT DESIGN</li> <li>TEST POINT TYPE, ACCESS AND SELECTION</li> <li>INTERCONNECTION DEVICE DESIGN</li> </ul> </li> <li>SPECIFICATION REQUIRES THAT A TRD BE GENERATED FOR EACH UUT TO ENABLE, AS A QUALITY ASSURANCE PROVISION, THE ASSESSMENT OF UUT TESTABILITY.</li> <li>SPECIFICATION REQUIRES THAT A COMPATIBILITY BASELINE BE ESTABLISHED FOR EACH UUT. THIS BASE-LINE ESTABLISHES THE CONFIGURATION BY WHICH UUT TESTABILITY WILL BE EVALUATED.</li> </ul>	<ul style="list-style-type: none"> <li>IS UNDERGOING REVISION SO AS TO MAKE DOCUMENT NOT PECULIAR TO VAST. DOCUMENT PRESENTLY BEING CONVERTED TO A MILITARY STANDARD.</li> <li>SPECIFIES TWO TEST POINT CATEGORIES: <ul style="list-style-type: none"> <li>FUNCTIONAL</li> <li>MAINTENANCE</li> </ul> </li> <li>SPECIFIES THAT TEST POINTS SHALL BE SELECTED AND ASSIGNED TO MEET F/I REQUIREMENTS OF AR-10.</li> </ul>
NAVAIR AR-10	MAINTAINABILITY OF AVIONICS EQUIPMENT AND SYSTEMS, GENER- AL REQUIREMENTS FOR.	SPECIFIES THE MAIN- TAINABILITY AND BUILT-IN-TEST REQUIREMENTS FOR AVIONICS EQUIP- MENT. SPECIFIES THAT TEST POINTS SHALL BE PROVIDED ON THE EQUIPMENT FOR ALL LEVELS OF MAINTENANCE.	<ul style="list-style-type: none"> <li>CONTAINS SPECIFIC REQUIREMENTS FOR: <ul style="list-style-type: none"> <li>VAST COMPATIBILITY</li> <li>CONSTRUCTION, PACKAGING, AND MODULARIZATION</li> <li>MAINTAINABILITY PROGRAM PLAN</li> <li>BUILT-IN-TEST (BIT) FUNCTION</li> <li>MAINTAINABILITY INDICES AND REQUIREMENTS</li> <li>TEST POINTS</li> <li>REPORTS</li> <li>MAINTAINABILITY ANALYSIS AND TESTS.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>SPECIFIES THAT TEST POINTS SHALL BE PROVIDED ON THE EQUIPMENT FOR THE FOLLOWING LEVELS OF MAINTENANCE: <ul style="list-style-type: none"> <li>DEPOT</li> <li>ORGANIZATIONAL</li> <li>INTERMEDIATE.</li> </ul> </li> </ul>

TABLE C-2. MAJOR BIT/TEST POINT/INTERFACE BUS RELATED DOCUMENT SUMMARY (Cont'd)

DOCUMENT	NAME	SCOPE	CONTENTS	NOTES
MIL-STD-1399 (SECTION 107)	INTERFACE STANDARD FOR SHIPBOARD SYSTEMS AUTOMATIC TESTING, ON LINE.	ESTABLISHES INTERFACE REQUIREMENTS FOR SHIPBOARD SYSTEMS/EQUIPMENT AND THE ON-LINE AUTOMATIC TEST SYSTEM.	<p>SPECIFIES:</p> <ul style="list-style-type: none"> <li>• INPUT IMPEDANCE CHARACTERISTICS OF THE TEST EQUIPMENT AT THE ATE/UUT INTERFACE</li> <li>• GROUNDING OF THE ATE/UUT</li> <li>• MEASUREMENT CHARACTERISTICS OF THE ATE</li> <li>• INTERFACE CONSTRAINTS               <ul style="list-style-type: none"> <li>- REQUIRES COMPATIBILITY OF ATE/UUT</li> <li>- SPECIFIES TEST POINT LOCATION AND CONSIDERATIONS</li> <li>- SPECIFIES UUT SENSOR REQUIREMENTS.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• DOCUMENT REFERENCES AND FOR THE MOST PART DUPLICATES MIL-STD-1326.</li> <li>• ATE AS DEFINED IN THIS SPECIFICATION IS OF THE "ON-LINE" PERFORMANCE MONITORING TYPE.</li> </ul>
IEEE STD 488-1975	IEEE STANDARD DIGITAL INTERFACE FOR PROGRAMMABLE INSTRUMENTATION.	THIS STANDARD APPLIES TO INTERFACE SYSTEMS USED TO INTERCONNECT BOTH PROGRAMMABLE ELECTRONIC MEASURING DEVICES WITH OTHER DEVICES AND ACCESSORIES NECESSARY TO ASSEMBLE INSTRUMENTATION SYSTEMS. IT APPLIES TO THE INTERFACE OF INSTRUMENTATION SYSTEMS, OR PORTIONS OF THEM, IN WHICH THE: <ol style="list-style-type: none"> <li>1) DATA EXCHANGE AMONG THE INTERCONNECTED DEVICES IS DIGITAL.</li> </ol>	<p>THE STANDARD SPECIFIES:</p> <ul style="list-style-type: none"> <li>• FUNCTIONAL CHARACTERISTICS OF THE BUS.</li> <li>• ELECTRICAL CHARACTERISTICS OF THE BUS.</li> <li>• MECHANICAL CHARACTERISTICS REQUIRED TO MATE WITH THE BUS.</li> <li>• SYSTEM APPLICATIONS AND GUIDELINES FOR THE DESIGN.</li> <li>• SYSTEM REQUIREMENTS AND GUIDELINES FOR THE USER.</li> </ul>	<ul style="list-style-type: none"> <li>• THE STANDARD DOES NOT SPECIFY THE DEVICE DEPENDENT OR OPERATIONAL CHARACTERISTICS REQUIRED FOR COMPLETE SYSTEM COMPATIBILITY - THEREFORE, FOLLOWING THE RULES AND PROCEDURES OF THIS STANDARD WILL NOT GUARANTEE UNCONDITIONAL COMPATIBILITY.</li> <li>• STANDARD DOES NOT SPECIFY UUT/ATE INTERFACE BUT THE CONTROLLER/ATE INTERFACE.</li> </ul>

TABLE C-2. MAJOR BIT/TEST POINT/INTERFACE BUS RELATED DOCUMENT SUMMARY (Cont'd)

DOCUMENT	NAME	SCOPE	CONTENTS	NOTES
IEEE STD 488-1975 (Cont'd)		<p>2) NUMBER OF DEVICES THAT MAY BE INTERCONNECTED BY ONE CONTIGUOUS BUS DOES NOT EXCEED 15M.</p> <p>3) TOTAL TRANSMISSION PATH LENGTH OVER THE INTERCONNECTING CABLES DOES NOT EXCEED 20M.</p> <p>4) DATA RATES ACROSS THE INTERFACE ON ANY SIGNAL LINE DOES NOT EXCEED 1 mbs.</p>		
MIL-STD-1326	TEST POINTS, TEST POINT SELECTION AND INTERFACE REQUIREMENTS FOR EQUIPMENTS MONITORED BY SHIPBOARD ON-LINE AUTOMATIC TEST EQUIPMENT.	THIS STANDARD ESTABLISHES THE REQUIREMENTS FOR PROVIDING TEST POINTS IN PRIME EQUIPMENTS FOR MONITORING BY ON-LINE AUTOMATIC TEST EQUIPMENT (ATE). IT PROVIDES CRITERIA FOR GUIDANCE IN OPTIMUM TEST POINT SELECTION. IT DEFINES INTERFACE AND DATA REQUIREMENTS, A SYSTEM OF TEST	<p>SPECIFIES THE REQUIREMENTS OF THE PROCURING ACTIVITY TO ACHIEVE THE FOLLOWING OBJECTIVES:</p> <ul style="list-style-type: none"> <li>• THE OPTIMUM SELECTION AND PLACEMENT OF TEST POINTS TO: <ul style="list-style-type: none"> <li>- CONTINUOUSLY MONITOR THE PERFORMANCE OF PRIME EQUIPMENT</li> <li>- INDICATE THE EXISTENCE OF A FAILURE</li> <li>- FACILITATE RAPID SOLUTION OF A FAILURE TO THE LINE REPLACEABLE UNIT TO EXPECT REPAIR BY SUBSTITUTION OF A</li> </ul> </li> </ul>	<p>SPECIFIES THE FOLLOWING:</p> <ul style="list-style-type: none"> <li>• ATE MEASUREMENT COMPATIBILITY REQUIREMENTS <ul style="list-style-type: none"> <li>- DC VOLTAGE MEASUREMENTS</li> <li>- AC VOLTAGE MEASUREMENTS</li> <li>- PULSE PARAMETER MEASUREMENTS</li> <li>- TIME INTERVAL MEASUREMENTS</li> <li>- FREQUENCY MEASUREMENTS</li> </ul> </li> <li>• TEST POINT SELECTION CRITERIA <ul style="list-style-type: none"> <li>- TYPES</li> <li>- VIRTUAL TEST POINTS</li> </ul> </li> </ul>



TABLE C-2. MAJOR BIT/TEST POINT/INTERFACE BUS RELATED DOCUMENT SUMMARY (Cont'd)

DOCUMENT	NAME	SCOPE	CONTENTS	NOTES
MIL-STD-1326 (Cont'd)		POINT DATA GENERATION, AND PROCEDURES FOR SUBMISSION OF DATA DISCLOSING THE SELECTIONS OF THESE TEST POINTS.	<ul style="list-style-type: none"> <li>• SPARE, PERFORMANCE OF REALIGNMENT, ETC.</li> <li>• THE PLANNING AND DEVELOPMENT OF AN ADEQUATE LEVEL OF TEST LOGIC DESIGN FOR THE PRIME EQUIPMENT.</li> <li>• THE DEFINITION OF THE TYPES OF TEST POINT SIGNALS TO BE PROVIDED FOR ATE MONITORING.</li> </ul>	<ul style="list-style-type: none"> <li>• POWER MONITORING TEST POINTS</li> <li>• MODE MONITORING TEST POINTS</li> <li>• SPECIAL TIME/INTERVAL FREQUENCY MONITORING TEST POINTS</li> <li>• PERFORMANCE MONITORING TEST POINTS</li> <li>• FAULT ISOLATION TEST POINTS.</li> </ul>
MIL-STD-1326A (PROPOSED)	TEST POINT, BUILT-IN-TEST AND TEST INTERFACE REQUIREMENTS FOR NAVY OPERATIONAL SYSTEMS.	ESTABLISHES REQUIREMENTS FOR PROVIDING TEST POINTS, BUILT-IN-TEST (BIT), AND A STANDARD DIGITAL INTERFACE (PER MIL-STD-1553) FOR DATA EXCHANGE BETWEEN PRIME EQUIPMENT AND ON-LINE ATE.	SIMILAR TO 1326 BIT PROVISIONS AND A STANDARD DATA INTERFACE REQUIREMENTS ADDED.	<ul style="list-style-type: none"> <li>• PROPOSED SPECIFICATION TECHNICALLY SHAKEY AND MISLEADING.</li> <li>• SPEC REFERENCES: <ul style="list-style-type: none"> <li>- MIL-STD-415</li> <li>- MIL-STD-1399</li> <li>- MIL-STD-1553</li> <li>- IEEE STD 488</li> <li>- BIT DESIGN GUIDE</li> <li>- MIL-STD-1519.</li> </ul> </li> </ul>
NAVMAT INST 3960.9	BUILT-IN-TEST (BIT) DESIGN GUIDE.	PRESENTS THE FUNDAMENTALS OF BIT AND PROVIDES AN OVERVIEW OF DIFFICULT APPROACHES AVAILABLE TO THE DESIGNER AND THE ACQUISITION MANAGER, AND DISCUSSES STANDARDIZATION METHODS FOR THE EVALUATION OF THE IMPLEMENTATION OF THESE DIFFERENT APPROACHES.	CONSISTS OF THE FOLLOWING: <ul style="list-style-type: none"> <li>• BIT CATEGORIZATION</li> <li>• REQUIREMENTS ANALYSIS</li> <li>• BIT DESIGN AND ANALYSIS GUIDELINES</li> <li>• SPECIFICATION OF BIT</li> <li>• BIT APPLICATION EXAMPLES.</li> </ul>	

TABLE C-2. MAJOR BIT/TEST POINT/INTERFACE BUS RELATED DOCUMENT SUMMARY (Cont'd)

DOCUMENT	NAME	SCOPE	CONTENTS	NOTES
TBD	STANDARD SIGNAL INTERFACES TO NAVY SHIPBOARD DATA MULTIPLEX SYSTEMS.	SPEC. IN PROCESS OF BEING DEVELOPED.	<ul style="list-style-type: none"> <li>SPECIFIES SERIAL DIGITAL WORD INTERFACE REQUIREMENTS FOR NAVY SYSTEMS/EQUIPMENTS.</li> </ul>	<ul style="list-style-type: none"> <li>SPEC EVOLVING AS PART OF SDMS DEVELOPMENT PROCESS.</li> </ul>

APPENDIX D

REVISED NMC PROGRAM PLAN  
EVENT CHART

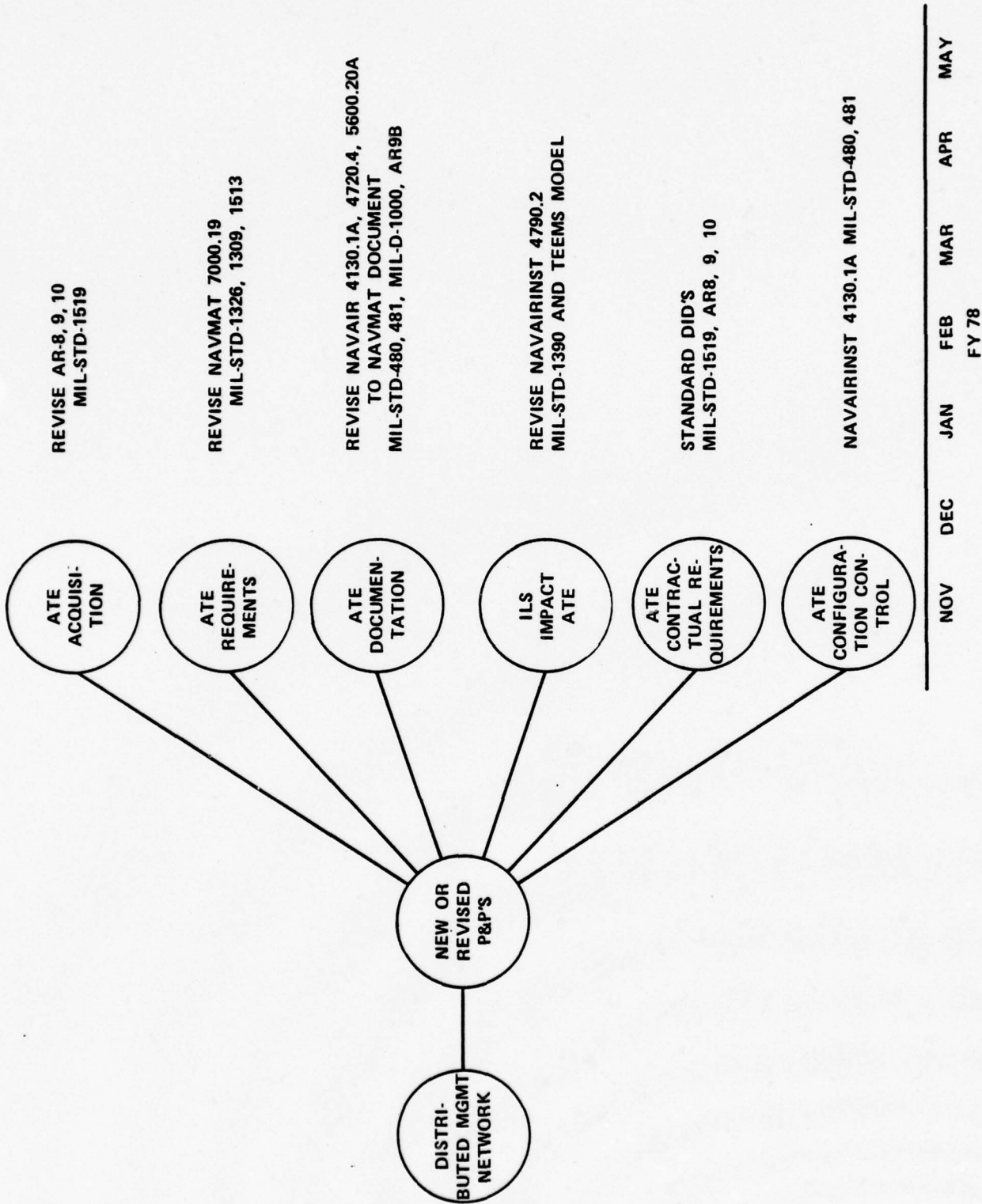


Figure D-1. Revised NMC Program Plan Event Chart.



APPENDIX E

EXCERPTS FROM  
REPORT OF INDUSTRY  
AD HOC AUTOMATIC TEST EQUIPMENT PROJECT  
VOLUME III MANAGEMENT CONSIDERATIONS

#### IV - TASK F - OPERATIONAL READINESS MONITORING SYSTEM (ORMS)

The NELC work to date has clearly established techniques for utilizing and displaying ORMS related data of the ship subsystems. However, the one thing that was not clear was what criteria should be used in a subsystem design for determining the subsystem output data requirements for ORMS. In general, the test points previously designed into the subsystems were intended for use in performance monitoring and maintenance. It has to be determined how to use the existing test points and outputs to establish the various levels of Operational Readiness. Each subsystem requires an analysis to determine its operational readiness levels. It is apparent that a military standard or specification is required that defines the guidelines to be used in specifying ORMS test points or data sources. A modified MIL-STD-1326 was considered to be a good vehicle for specifying ORMS related test point requirements.

The task group has prepared an ORMS Implementation Plan as an addendum to this report which outlines:

- o The evaluation of the ORMS concept on an existing ship class (FF-1052).
- o The evaluation of the ORMS concept for a future ship class (FF-7 LBTC).
- o The preparation of a modified MIL-STD-1326 for use as monitoring, interface and test point standard.

TASK F ADDENDUM  
OPERATIONAL READINESS MONITORING SYSTEM (ORMS)  
IMPLEMENTATION PLAN

9. MODIFICATION OF MIL-STD-1326

The scope of MIL-STD-1326 is to describe the requirements for providing test points and test interfaces in shipboard prime equipment; to provide criteria for guidance in optimum test point selection; and to define test point interface requirements, data generation requirements, and test point selection documentation procedures.

Some of the areas in which MIL-STD-1326 should be revised to reflect ORMS requirements are:

- o The standard should include an overall shipboard system testing/ORMS philosophy that will result in the proper degree of BITE in new development hardware.
- o The standard should define the interface requirements between internal BITE and external functions such as GPETE, ORMS, etc.
- o The standard should define which standard interfaces are mandatory; i.e., if the designer chooses to bring out analog or digital signals, what is the analog/digital interface?
- o Overall system guidance regarding the total ship ORMS must be provided with respect to logical processing required of the designer's equipment relative to ORMS, availability of external stimuli, and external multiplexing control.
- o Guidance is required regarding the difference between test points that are brought to locally accessible points (such as card edge) and test points that are brought to a rear-panel connector for distribution (possibly via a multiplex bus system) to remote monitoring/processing in other equipment or systems.
- o Clarification of the definition of passive sensor is required in light of the desire to encourage standard digital interfaces.

## VI - TASK I - SPECIFICATION REVIEW

MIL-STD-1326 and the draft MIL-STD-1326A are concerned with test points, test point selection and interface requirements for equipment monitored by shipboard on-line ATE. These standards are of major concern to the Task F effort on Operational Readiness Monitoring Systems (ORMS). Pertinent recommendations from the Task F report are presented with the comments of the Task I Specification Review group.



APPENDIX F

RECOMMENDED NAVMAT INSTRUCTIONS

## APPENDIX F

This appendix provides sample NAVMAT instructions to establish policy for (1) Testability of New Systems, and (2) Standard ATE Related Data Item Descriptions (DID). Sample DIDs are provided herein.

The NAVMATINST numbers assigned are arbitrary and do not reflect actual instructions generated.

DEPARTMENT OF THE NAVY  
Headquarters Naval Material Command  
Washington, D.C. 20360

NAVMATINST 3960.10  
MAT 04T/GWN  
1 September 1977

NAVMAT INSTRUCTION 3960.10

From: Chief of Naval Material

Subj: Testability of New Systems

Ref: (a) NAVMATINST 3910.5C subj: Technical Development Plans (TDPs) and Research and Development Planning Summaries (DD Forms 1634); Procedures for Preparation, Submission and Distribution

(b) NAVMATINST 3960.9 subj: Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment; Built-in-Test (BIT) Design Guide; Promulgation of

(c) NAVMATINST 4000.20B subj: Integrated Logistics Support (ILS) Planning Policy

(d) NAVMATINST 3960.4A subj: Policy and Responsibility for Automatic Test, Monitoring and Diagnostic Systems and Equipment

1. Purpose. To assist project managers in their efforts to encourage contractors to design a supportable system at a reduced life cycle cost.

2. Background. The design of a military system and its elements has in the past often been driven only by performance considerations, while maintenance was considered as an afterthought. Design of special test equipment to test the system was accomplished after the fact as best as could be expected. By utilizing a design team composed of representatives from design, test, maintainability, logistics, reliability, systems analysis, packaging, and software/firmware, many of the downstream maintenance and logistics problems can be avoided. Reference (a) provides a checklist for each of the disciplines during the development phase of a program.

Specifying in the RFP or systems specification that each element within the system must be designed for testability results in lower maintenance and life cycle costs, higher operational readiness and savings in space for and the need of special test equipment.

1 September 1977

Current technology enables the design of built-in-test with a very low overhead growth (Ref. (b)) provided the designer makes each design decision with other team members. Development of the maintenance concept in the past occurred after the design was developed or without knowledge of the detailed design. The designer, on the other hand, was not required to consider the mission or the maintenance policy.

3. Policy. Project and acquisition managers shall require the establishment of a contractor design team with representatives from design, test, logistics, maintainability, systems analysis, reliability, software/firmware, and packaging as members. From inception of the design each design decision shall be approved by all members of the team. Frequent design reviews held with appropriate members of the team and others, chaired by the project manager or his representative, shall be conducted. As a minimum, decisions such as placement of test points, accessibility, partitioning, bus arrangements, redundancy, fault detection and isolation shall be made by the design team. Sufficient notice and information on the latest design configuration shall be given all review members prior to the review. Trade studies concerning BIT level, BIT versus ATE, optimum test point selection, software versus hardware BIT, repair-discard level and their relationship to mean time to repair and mean time between failure shall be conducted during this design process. Methodology for developing a figure of merit for the systems' testability shall be developed by each contractor subject to the approval of the project office. Design improvements during the design process shall be measured against this baseline.

4. Scope and Applicability. This policy applies to all Systems Commands, CNM-designated Project Managers' Offices and CNM laboratories, and includes all platform, system and equipment acquisitions for which ATE/BIT applications are established or projected. This includes self-test, and all automatic and semi-automatic test and monitoring equipment as defined in Reference (d).

5. Action.

a. Addressees shall:

- (1) Implement the policy as stated through specific reference to this document in applicable acquisition planning and procurement directives and review procedures.
- (2) Ensure that new and planned acquisition programs are structured and implemented to reflect the guidelines provided.

b. The Naval Material Command (MAT 04) shall monitor the overall adequacy of ATE acquisition planning and implementation on the basis of conformance with this policy.



DEPARTMENT OF THE NAVY  
Headquarters Naval Material Command  
Washington, D.C. 20360

NAVMATINST 3960.11  
MAT 04T/GWN  
1 September 1977

NAVMAT INSTRUCTION 3960.11

From: Chief of Naval Material

Subj: Standard ATE Related Data Item Descriptions (DIDs)

- Ref: (a) NAVMATINST 3960.9 subj: Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment; Built-in-Test (BIT) Design Guide; Promulgation of
- (b) NAVMATINST 4000.20B subj: Integrated Logistics Support (ILS) Planning Policy
- (c) NAVMATINST 3960.4A subj: Policy and Responsibility for Automatic Test, Monitoring and Diagnostic Systems and Equipment

Encl: Data Item Descriptions and Contract Data Requirements Lists

1. Purpose. To assist project managers to specify data required for ATE/BIT acquisitions. Application of the enclosure in the acquisition process of platforms, systems and equipment (end items) will provide assurance of proper deliverables for effective maintenance of the end items.
2. Background. Development of end-items requires that support equipment be developed concurrently. With the advent of complex end-items, the need to develop automatic test equipment (ATE) to detect and isolate faults for maintenance purposes and built-in-test (BIT) for readiness indications became urgent. Along with the development of ATE/BIT, the requirements for test programs, operator manuals, test specifications, etc., was generated. To properly specify how these deliverables are to be developed, so that the Fleet will understand the operation of the hardware and software, standard DIDs and CDRLs have been developed (enclosure).
3. Policy. Enclosures are provided for use by project managers and other acquisition managers to acquire ATE and BIT for their end-items. The enclosures cover acceptance and qualification testing data, unit under test (UUT) test plans and procedures, test reports, users manuals, software specifications and self-test design analysis. The enclosures are presented as guidance and do not necessarily represent a complete DID/CDRL package, although for most ATE/BIT they will suffice.

4. Scope and Applicability. The foregoing policy applies to all Systems Commands, CNM-designated project managers' offices and CNM laboratories, and covers all platform, system and equipment acquisitions for which ATE applications are established or projected. ATE applications include BIT, self-test, and all automatic and semi-automatic test and monitoring equipment as defined in Reference (a).

5. Action.

a. Addressees shall:

- (1) Implement the policy as stated through specific reference to this document in applicable acquisition planning and procurement directives and review procedures.
- (2) Ensure that new and planned acquisition programs are structured and implemented to reflect the guidelines provided.

b. The Naval Material Command (MAT 04) shall monitor the overall adequacy of ATE acquisition planning and implementation on the basis of conformance with this policy.

NAVMAT INSTRUCTION 3960.11

ENCLOSURE

ATE/BIT RELATED DIDs/CDRLs

DATA ITEM DESCRIPTION	2. IDENTIFICATION NO(S).	
	AGENCY	NUMBER
<b>1. TITLE</b>  UUT ACCEPTANCE TEST PROCEDURE		
<b>3. DESCRIPTION/PURPOSE</b>  This data item provides procedures for tests (and inspections) to be conducted for determining acceptability of Subsystem/Equipment to be furnished to the Navy.  This information is used to equate the Contractor's acceptance test activity to the acquisition specification test requirements.	<b>4. APPROVAL DATE</b>	
	<b>5. OFFICE OF PRIMARY RESPONSIBILITY</b>	
	<b>6. DOC REQUIRED</b>	
	<b>8. APPROVAL LIMITATION</b>	
<b>7. APPLICATION/INTERRELATIONSHIP</b>  Applies to acquisitions involving new or modified hardware end items where acceptance testing is required.	<b>9. REFERENCES (Mandatory as cited in block 10)</b>  MIL-STD 1519 AR 8, 9 & 10	
	<b>10. PREPARATION INSTRUCTIONS</b>	
<p>Acceptance test procedures shall be prepared as working documents containing sufficient detail so that they may be used for conducting the tests to which they apply. They shall include the following information as a minimum, and may be prepared in Contractor's format.</p> <ol style="list-style-type: none"> <li>Document identification number, date, and revision information.</li> <li>Manufacturer's name and division, as applicable.</li> <li>Signature(s) of supplier personnel responsible for validity of the document.</li> <li>Description of test item, including manufacturer's part number and name of item.</li> <li>Number, date, and revision of applicable procurement specification. If desired, the parenthetical expression "(latest contractual revision)" may be used following the specification number in lieu of date and revision information.</li> <li>Test number for each specific test described, and sequence with regard to associated tests.</li> <li>Title of each specific test described.</li> <li>Correlation of each test to the corresponding paragraph number(s) of applicable acquisition specification.</li> </ol>		



UUT ACCEPTANCE TEST PROCEDURE

Preparation Instructions (Continued)

9. Quantity to be tested (specify all parts, or else describe the intended sampling plan).
10. Quantitative and/or qualitative success criteria for each test.
11. Action to be taken if success criteria are not achieved.
12. The environmental conditions under which the test is to be conducted, with tolerances.
13. The test configuration, including mounting position/attitude of the test item during the test.
14. If applicable, the power supplied to the item under test, with tolerances.
15. A detailed statement of exactly how each test is to be performed. The level of detail shall be such that the statement may be used as direct and adequate instructions to performing test personnel experienced in the type of testing described but not necessarily knowledgeable of the item to be tested.
16. Data to be recorded and data reduction and analysis techniques. Include sample data sheet(s).
17. Description of support equipment and/or special test facilities required.
18. Description of instrumentation, including:
  - a. Sensing and recording devices (name, range, rated accuracy and, if appropriate, manufacturer and model number. For rated accuracy expressed in percent, specify percent of reading or percent of full-scale indication, as applicable.)
  - b. Parameters to be sensed or recorded, correlated to the devices to be used.
  - c. Calibration frequency, methods of calibration, and calibration standards (if applicable, acknowledge compliance with MIL-C-45662A without presenting detailed statement of standards and methods.)
  - d. Checkout and/or standardization procedure if required in addition to calibration.
  - e. A requirement for instrument error to be taken into account in determining allowable limits of instrument readings.
19. Identification of figures and tables.
20. Definitions of uncommon acronyms, symbols, and abbreviations.

ATCH NR _____ TO EXHIBIT _____		CONTRACT DATA REQUIREMENTS LIST				ATE/UUT		SYSTEM ITEM COMPATIBILITY					
TO CONTRACT PR _____		CATEGORY _____		CONTRACTOR _____									
1. SEQUENCE NUMBER	2. TITLE OR DESCRIPTION OF DATA	3. SUBTITLE	4. AUTHORITY (Data Item Number)	5. CONTRACT REFERENCE	6. TECHNICAL OFFICE	7. APP. INPUT REQ (A)	8. INPUT (X)	9. AS OF DATE	10. FREQUENCY	11. DATE OF SUBSEQUENT SUBM EVENT 10	12. DATE OF 1ST SUBMISSION	13. DISTRIBUTION AND ADDRESSEES (Addresses - Regular Copies Repro Copies)	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
	UUT Acceptance Test Procedures												
2.					LT	A			BLK 16	BLK 16	BLK 16	6/0	
3.													
4.	1. Acceptance Test Procedures shall be submitted 90 days prior to start of tests, or concurrent with submittal of Qualification Test Procedures, whichever occurs first.												
5.													
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DATA ITEM DESCRIPTION		2. IDENTIFICATION NO(S).	
		AGENCY	NUMBER
1. TITLE  USERS MANUAL (TEST PROGRAMS)			
3. DESCRIPTION/PURPOSE  This manual is used to provide the Navy and/or contractor personnel with the necessary instructions concerning usage of the test program and instructions on how it is to be operated.		4. APPROVAL DATE	
		5. OFFICE OF PRIMARY RESPONSIBILITY	
		6. DDC REQUIRED	
		7. APPROVAL LIMITATION	
7. APPLICATION/INTERRELATIONSHIP  The basis for the development of the Users Manual is the Navy's specifications. The manual will normally be submitted to the procuring activity at the time of acceptance of the test program to which it relates.		8. REFERENCES (Mandatory as cited in block 10)  AR-9B	
		MCSL NUMBER(S)	
10. PREPARATION INSTRUCTIONS			
<p>1. <u>Content</u>. The users manual for a test program system shall contain the following:</p> <p>a. <u>Introduction</u>. A description of the manual's purpose, scope, organization, and content.</p> <p>b. <u>Glossary</u>. Terms used in the manual.</p> <p>c. <u>Test Program Capabilities</u>:</p> <p>(1) Purpose. A description of the purpose of the test program.</p> <p>(2) General Description. A description of the system, giving an overview of the system and its operation.</p> <p>(3) Functions Performed. Identification of the specific functions performed by the test program. (This may be in terms of systems operations, uses, outputs, etc.)</p> <p>d. <u>Function Description</u>. A description of each specific function within the test program. The following subparagraphs shall be repeated for each function:</p> <p>(1) Title of function. A descriptive title of the specific function.</p>			

USERS MANUAL (TEST PROGRAMS)

Preparation Instructions (Continued)

- (2) Description of function. A summary description of the specific function, including:
  - (a) Purpose and uses of function.
  - (b) Description of system inputs.
  - (c) Description of expected output and results.
  - (d) Relationship to other functions.
  - (e) Summary of function operation.
- e. Usage Instructions. How to use each specific function. This shall include the following:
  - (1) Preparation of inputs. A definition of the system inputs, other than those required to operate the test program (see paragraph 1f(2)). These inputs constitute the basic data that are to be processed by the test program. The definition shall include:
    - (a) Title of inputs.
    - (b) Description of inputs.
    - (c) Purpose and use.
    - (d) Input media.
    - (e) Limitation restrictions.
    - (f) Format and content.
    - (g) Sequencing (e.g., formalized deck structure).
    - (h) Special instructions.
    - (i) Relationship of inputs to outputs.
  - (2) Results of Operation. A definition of expected results after completion of test program operation.
    - (a) Description of results.
    - (b) Form in which results will appear.
    - (c) Output format and content.
    - (d) Instruction on use of outputs.
    - (e) Limitations/restrictions.
    - (f) Relationship of outputs to inputs.
    - (g) Examples.
- f. Operating Instructions. Procedures required to operate the test program. It shall include the following:
  - (1) Operating procedures. The step-by-step procedures required to:
    - (a) Initiate the test program. Procedures shall include reading the test program into the computer, establishing the required mode of operation (if more than one), initially setting required parameters, providing for inputs and outputs, and operating the test program.



Preparation Instructions (Continued)

- (b) Maintain test program operation. Procedures shall be specified to maintain operation of the test program where operator intervention is required.
  - (c) Terminate and restart the test program. Procedures shall be specified for normal and unscheduled termination of test program operation, as well as restarting the test program.
  - (d) Software system generation procedures. This section shall include both the routine intervention required and such special topics as procedures to enable operators and/or programmers to "octal-in" corrections or to change the test program without recompiling the program or building a new system master tape. Procedures should also be included that are necessary to create a new version of the master code media (for example, master tape).
  - (e) Symbolic updating procedures. This section shall describe the procedures to be followed to effect symbolic changes to the software system. This discussion should present a step-by-step description of the updating processes. As necessary, appropriate data sets and inputs will be described.
- (2) Operator inputs. A complete description of all the control cards and card formats of the test program, including the function or purpose of each field, will be given. All inputs, other than those described in paragraph 1e(1), required to operate the test program will be defined in a similar manner as follows:
- (a) Title of input.
  - (b) Purpose and use.
  - (c) Input media.
  - (d) Limitations/restrictions.
  - (e) Format and content.
- (3) Operator outputs. A complete description of the output formats, other than those described in paragraph 1e(2), of the test program. This shall include samples of each type of possible output format. Furthermore, a cross-reference list between output fields and input control card fields will be given, so that the test program user may readily determine the effect of certain input fields on each output field. This subparagraph shall include, but not be limited to, the following:
- (a) Title of output.
  - (b) Purpose and use.
  - (c) Output media.
  - (d) Output format.
  - (e) Output content (symbols, codes, etc.).

Preparation Instructions (Continued)

- g. Appendix. The appendix may include information bound separately for convenience, as in the case of classified appendix or a large body of data.
2. Concept. Manual content and format shall be specifically designed to meet the needs of the intended user. The following principles further explain the users manual concept:
- a. Each manual shall be organized to explain the system in terms of application and operation.
  - b. Each manual shall be as self-contained as possible. Reference to other documents should be minimal.
  - c. The level of comprehension for each manual shall be appropriate for the intended user of the manual. When different kinds of users are involved, the manual shall be written so that all users can comprehend the contents. Skill level 5 shall determine the base comprehension level unless otherwise specified.
  - d. Text shall be factual, concise, specific, clearly worded, and illustrated. Sentence form shall be simple and direct. Abbreviated tabular data such as charts, tables, checklists and diagrams shall be employed, whenever practicable, in lieu of written text.
  - e. Technical knowledge reflected in the manual shall be converted into the most easily understood wording possible. Discussions of theory shall be omitted except where essential for practical understanding and application. Phraseology requiring a specialized knowledge shall be avoided, except where no other wording will convey the intended meaning. The primary emphasis will be placed upon the specific steps to be followed, the results which may be expected or desired, and the corrective measures required when such results are not obtained.
3. Production Requirements:
- a. Users manuals shall be designed for economy of initial production with respect to time. This implies use of a standardization format. Basic format shall be consistent between and within chapters in the manual so that mass production data preparation techniques may be employed.
  - b. Users manuals are designed for economy of production with respect to maintenance. This implies:
    - (1) Modular construction. Functions shall be kept separate within text to facilitate maintenance procedures.
    - (2) Minimal sequencing. Unnecessary numbering of sections, paragraphs, tables, and figures is to be avoided within the manual so that periodic revisions can be accomplished with a minimum of related sequence changes to the manual.

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## Preparation Instructions (Continued)

- c. Relaxed format and reproduction methods shall be permitted for any material that must be prepared by the contractor or agency furnishing the manual. Areas which may be relaxed are as follows:
    - (1) Type continuous across the page.
    - (2) Use of standard typewriter to prepare reproduction copy.
    - (3) Use of freehand lettering on illustrations.
    - (4) Use of office-type reproduction equipment.
    - (5) Uniform lettering size on final copy not required.
  - d. Illustration procedures shall be standardized to make possible the liberal use of scripting examples, output samples, and other art work.
4. Design Requirements. The primary requirement of users manual design is that the manual shall be usable by the intended audience. In addition the following specific requirements shall be met:
- a. Format. Each document shall have the following structural parts: a title page, a release page, a change log, a table of contents, the main body of text, a glossary, and illustrations. Optional parts are a list of figures or illustrations, a list of tables, appendixes, and an index. Each page of the manual shall contain the release date, page number, document number, and page content heading.
    - (1) The title page contains the title of the manual, the contract end item number, and the date of the manual. It shall be prepared under relaxed format style.
    - (2) The release page contains a description of the version of the computer program system with which the users manual is compatible.
    - (3) The change log indicates change pages and shows the publication date of each page.
    - (4) The table of contents contains a list of topic headings taken from the main body of the text. The page number of the topic headings shall be listed.
    - (5) The optional list of figures or illustrations contains a list of the titles of figures or illustrations. The page numbers of the figures or illustrations shall be listed.
    - (6) The optional list of tables contains a list of table titles. The page numbers of the tables shall be listed.
    - (7) The main body of the text is divided into chapters. Each main topic shall constitute a chapter.
    - (8) The glossary shall contain all specialized terms used within the manual.
    - (9) The optional appendixes may contain any auxiliary material deemed necessary in the use of the users manual or the computer program system. Examples are tables and worksheets.
    - (10) The optional index contains reference page numbers of each topic listed.



Preparation Instructions (Continued)

- b. Pagination. Pages may be numbered consecutively throughout the document, or through a chapter only.
- c. Topic Headings. Topic headings shall indicate clearly the order of subordination. Parts, chapters, sections, paragraphs, figures, and tables shall have brief descriptive titles. Major headings may be centered. Subordinate topic headings shall be left-justified on the page. Run-in headings may be used if further subordination is required.
- d. Illustrations and Diagrams. The illustrations and diagrams for users manuals shall be prepared under relaxed format style. Illustrations and diagrams shall be used in lieu of text whenever this technique will result in a more effective presentation of information.
- e. Nomenclature. Nomenclature used shall be consistent throughout a particular set of users manuals. Standard acronyms and abbreviations may be used provided they are first defined in the text. They shall also be defined in the glossary.
- f. Space Conservation. Layout shall not constrain usability or clarity of material. If white space increases communication effectiveness, blank portions of pages shall be permitted.
- g. Users Aids. Summaries and printed tables shall be provided where appropriate to aid the user of the manual.
- h. Collating, Drilling, and Binding. Collating, drilling, and type of covers shall be as directed by the procuring activity and/or user agency.



DATA ITEM DESCRIPTION	2. IDENTIFICATION NO(S).	
	AGENCY	NUMBER
1. TITLE SELF-TEST DESIGN ANALYSIS FOR SUPPORT EQUIPMENT		
3. DESCRIPTION/PURPOSE To establish the design concepts by which the seller plans to support and implement self test requirements.	4. APPROVAL DATE	
	5. OFFICE OF PRIMARY RESPONSIBILITY	
	6. DDC REQUIRED	
	8. APPROVAL LIMITATION	
7. APPLICATION/INTERRELATIONSHIP  This data item is utilized to obtain the analysis for the Automatic Test Equipment.	9. REFERENCES (Mandatory as cited in block 10)  AR 10-A MIL-STD 1519	
	MCSL NUMBER(S)	
10. PREPARATION INSTRUCTIONS		
<p>I. Describe rationale used in mechanization of the equipment's self test capabilities.</p> <p>II. Provide self test design information for the following areas:</p> <p>A. Identify and describe in detail:</p> <ol style="list-style-type: none"> <li>1. Self test operating modes</li> <li>2. Equipment failure modes and relative failure rates               <ol style="list-style-type: none"> <li>(a) All WRA failure modes, differentiating Interface Unit (IU) failure modes from others associated with the equipment.</li> <li>(b) Failure modes affecting safety.</li> <li>(c) Failure modes to be detected by self test.</li> </ol> </li> <li>3. Each manual non-automatic test operation (if subsystem contains man/machine interface).</li> <li>4. Any time - dependent constraints to testing.</li> </ol>		



SELF-TEST DESIGN ANALYSIS FOR SUPPORT EQUIPMENT (Continued)  
Preparation Instructions

B. Provide and discuss:

1. Schematic diagrams showing implementation of self test, self test circuit isolation and test point locations.
2. Block diagrams showing self test functional areas and signal flow.
3. Calculations of fault detection capabilities (percent assurance).
4. Calculations of fault isolation capabilities (percent certainty).

C. Design approach to achieve a 95% fault detection capability and 95% fault isolation certainty.

1. The 95% probability shall be calculated based on the weighted failure rates.

NOTE: Computer programming shall be utilized to the maximum extent possible for performance, evaluation and identification of self test operational modes and failures. Detection and isolation information may be used by the computer program to provide regressive modes of operation.

D. Describe the self test approach as required above and discuss the impact of the self-test design on the hardware part count, weight, and volume. In addition, identify the percentage of weight which is attributed to self test.





DATA ITEM DESCRIPTION	2. IDENTIFICATION NO(S).	
	AGENCY	NUMBER
1. TITLE TEST PROGRAM FORMAT REQUIREMENTS (SOFTWARE)		
3. DESCRIPTION/PURPOSE  To define the requirements for the format of deliverable test programs.	4. APPROVAL DATE	
	5. OFFICE OF PRIMARY RESPONSIBILITY	
	6. DOC REQUIRED	
	8. APPROVAL LIMITATION	
7. APPLICATION/INTERRELATIONSHIP  These data requirements apply to all test programs delivered by the seller. Test Program Flowcharts Standards shall be as specified in the test instructions and shall be delivered as part of this data item. Test Program Coding Standards shall be as specified in the TRD and shall be delivered as required as part of this data item.	9. REFERENCES (Mandatory as cited in block 10)  MIL-STD 1519 AR 9A	
	MCSL NUMBER(S)	
10. PREPARATION INSTRUCTIONS		
<ol style="list-style-type: none"> <li>1. Test Requirement Documents (TRD's) shall be prepared in accordance with MIL-STD-1519</li> <li>2. Program listings shall be delivered for each individual routine furnished. Each listing shall be prepared in the ATLAS language.</li> <li>3. Test programs shall have appropriate flowcharts as specified in computer Software Flowchart(s) Standards, and shall meet the requirements of the TRD.</li> <li>4. Source programs shall be furnished in card image on magnetic tape and as punched card decks. Preparation of source cards shall conform to Computer Software Coding Standards,</li> <li>5. Object programs shall be prepared in machine language and submitted: a) on magnetic tape; b) as punched card decks.</li> <li>6. All program tables and files necessary for the successful execution of programs shall be delivered in the formats required by the TRD's. They shall be submitted on magnetic tape, card deck or drum.</li> </ol>		





DATA ITEM DESCRIPTION		2. IDENTIFICATION NO(S).	
		AGENCY	NUMBER
1. TITLE PROGRAMMER'S NOTEBOOK			
3. DESCRIPTION/PURPOSE  This notebook is used to provide Navy personnel with the necessary information that is an extension to the programming manual. The notebook further explains the use of instructions or sequences of instructions for a particular type of function. The notebook will be compiled by the lead programmer for each test station.		4. APPROVAL DATE	
		5. OFFICE OF PRIMARY RESPONSIBILITY	
		6. DDC REQUIRED	
		6. APPROVAL LIMITATION	
7. APPLICATION/INTERRELATIONSHIP  The basis for the notebook will be the experiences and special programming tools delivered by the programmers as a result of their experiences on the test stations. The notebook will be submitted with acceptance of each station.		9. REFERENCES (Mandatory as cited in block 10)	
		MCSL NUMBER(S)	
10. PREPARATION INSTRUCTIONS			
<p>1. <u>Content</u>. The programmer's notebook shall be an informal loose leaf notebook maintained by the lead programmer for each test station. It shall be used to document experience in programming the computer and test station. A separate notebook shall be delivered with each test station upon acceptance of the test station.</p> <p>a. <u>Introduction/Nomenclature</u> A description of the station, station serial number and other identifying nomenclature.</p> <p>b. <u>Glossary</u> Terms peculiar to this particular test station. Actions that are peculiar to the individual test station.</p> <p>c. <u>Test Station Programming Extensions</u></p> <ul style="list-style-type: none"> <li>(1) Areas of Extensions.</li> <li>(2) Description of Extensions.</li> <li>(3) Methods of use.</li> <li>(4) Limitations.</li> <li>(5) Implementing Procedures.</li> <li>(6) Operating Instructions.</li> </ul> <p>2. <u>Concept</u>. Notebook content and format shall be specifically designed to meet the needs of the intended user - the test station test programmer. Reference to other documents should be minimal.</p>			



ATCH NR _____ TO EXHIBIT _____		CONTRACT DATA REQUIREMENTS LIST										ATE/UUT SYSTEM ITEM <u>Compatibility</u>	
TO CONTRACT PR _____		CATEGORY _____										CONTRACTOR _____	
1. SEQUENCE NUMBER	2. TITLE OR DESCRIPTION OF DATA 3. SUBTITLE	4. AUTHORITY (Data Item Number)	5. CONTRACT REFERENCE	6. TECHNICAL OFFICE	7. DD200 CONTRACT REQ	8. APP CONF TAG	9. INPUT TAG	10. FREQUENCY	11. AS OF DATE	12. DATE OF SUBM EVENT ID	13. DATE OF SUBSEQUENT SUBM EVENT ID	14. DISTRIBUTION AND ADDRESSEES (Addressee - Regular Copies Report Copies)	
1.	10	Programmer's Notebook						Blk 16		Blk 16			
2.								Blk 16		Blk 16			
16. REMARKS													
1. Initial submittal NLT 30 days before start of Acceptance Testing of the first Automatic Test Station.													
2. Submit changes, if any, quarterly.													
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16. REMARKS													
(Continued from above)													
NOTE: Submittal shall consist of a Programmer's Notebook for each test station. The notebook shall be delivered once with updates per each change submittal.													
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DATA ITEM DESCRIPTION		2. IDENTIFICATION NO(S).	
		AGENCY	NUMBER
1. TITLE MINUTES OF TEST PROGRAM DESIGN REVIEW AND AUDITS			
3. DESCRIPTION/PURPOSE  Data resulting from minutes and audit will enable project manager to determine the status of test program developments to allocate budget and manpower.		4. APPROVAL DATE	
		5. OFFICE OF PRIMARY RESPONSIBILITY	
		6. DOC REQUIRED	
		8. APPROVAL LIMITATION	
7. APPLICATION/INTERRELATIONSHIP  Used to determine effectiveness and status of test programs being developed for the ATE and interfaces.		9. REFERENCES (Mandatory as cited in block 1C)	
		MCSL NUMBER(S)	
10. PREPARATION INSTRUCTIONS  Regular periodic design reviews and audits of the progress of test program development shall be recorded and transmitted in the contractors legible format.			

ATE/UUT SYSTEM ITEM Compatibility		CONTRACT DATA REQUIREMENTS LIST										CONTRACTOR	
ATCH NR _____ TO EXHIBIT _____		CATEGORY _____		DISTRIBUTION AND ADDRESSEES (Addressee - Report Copies Report Copies)		DATE OF SUBMISSION		DATE OF SUBSEQUENT SUBM EVENT ID		TOTAL			
1. SEQUENCE NUMBER	2. TITLE OR DESCRIPTION OF DATA	3. SUBTITLE	4. AUTHORITY (Data Item Number)	5. CONTRACT REFERENCE	6. TECHNICAL OFFICE	7. APP CODE TO IAC REQ (AI)	8. INPUT (AI)	9. AS OF DATE	10. FREQUENCY	11. DATE OF SUBMISSION	12. DATE OF SUBSEQUENT SUBM EVENT ID	13. TOTAL	
1.	Minutes of Test Program Design Review and Audits								Blk 16	Blk 16			
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DATA ITEM DESCRIPTION		2. IDENTIFICATION NO(S).	
		AGENCY	NUMBER
1. TITLE SYSTEM/DESIGN TRADE STUDY REPORTS			
3. DESCRIPTION/PURPOSE  Provides data relating to design decisions including BIT level, cost, maintenance policy, test point selection, maintainability and other tradeoffs.		4. APPROVAL DATE	
		5. OFFICE OF PRIMARY RESPONSIBILITY	
		6. DOC REQUIRED	
		8. APPROVAL LIMITATION	
7. APPLICATION/INTERRELATIONSHIP  Used to determine basis for design decisions and maintenance strategy.		9. REFERENCES (Mandatory as cited in block 10)  AR 10A, 21, 30A NAVMATINSTR 3960.0 MIL-STD 1304(AS) MIL-STD 1390A MIL-STD 1388 MIL-STD 847 MIL-STD-1519	
		MCSL NUMBER(S)	
10. PREPARATION INSTRUCTIONS  Submit details and results of tradeoff study reports including determination of:			
<ul style="list-style-type: none"> <li>o BIT level (detection and isolation)</li> <li>o Maintenance policy</li> <li>o Testability level</li> <li>o Reliability</li> <li>o Maintainability</li> <li>o Hardware and software growth due to BIT</li> <li>o ATE selection</li> <li>o Adapter and interface configurations</li> </ul>			
10.1 Unless otherwise indicated herein, documents cited in this block shall be of the issue in effect on the date of invitation for bids or request for proposals or quotations and shall form a part of this Data Item Description to the extent specified herein.			
10.2 <u>Format</u> . This report shall be prepared in accordance with MIL-STD-847.			
10.3 <u>Content</u> . This report shall contain the design trade-offs conducted as part of the Reliability and Maintainability Program to ensure testability and supportability of the end item. Analyses to prepare test requirements data, procedures and guidelines to be used in this effort are described in the Naval Material Command (MAT-04T) documents entitled "Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment" dated 1 July 1976 and			



## SYSTEM/DESIGN TRADE STUDY REPORTS

## Preparation Instructions (Continued)

10.3 Content (Continued)

"Built-In-Test (BIT) Design Guide" dated 1 July 1976. The contractor shall utilize the above cited documents in the acquisition process of platforms, systems and equipment (end items) to provide assurance of early identification of ATE requirements, proper definition of the requirements in contractual documents, and systematic appraisal and implementation of ATE requirements during design and development of the end item. The results should provide for a more operationally effective and supportable weapon system at an acceptable life cycle cost.

a. The Test Requirements Analysis (TRA) is to be performed at both the conceptual (System) and Development (Equipment) phase during normal program evolution. At the conceptual phase, the TRA serves as a vehicle by which operational and system requirements evolve a preliminary ATE support concept. This concept is formulated in an iterative system engineering design process and it provides goals and objectives to the equipment designer for him to perform detailed WRA (Weapons Replaceable Assembly) and SRA (Shop Replaceable Assembly) development on-line with the system maintenance concept. The preliminary or System Test Requirement Analysis conducted during the conceptual phase serves as an input into the system design and Integrated Logistics Support Process.

b. At the conclusion of the validation phase of program development, candidate UUTs (Unit-Under-Test) for off-line testing should be identified based on Level of Repair Analysis (LORA), Logistic Support Analysis (LSA), and design trade-off analysis. Detailed design information for these candidate UUTs should then be utilized as source documentation for Equipment Test Requirement Analysis. This analysis should be performed as per MIL-STD-1519 with exception/modifications as required and approved by NAVAIR. The Equipment TRA when executed per MIL-STD-1519 manifests itself in a normalized UUT data base end item called the Test Requirements Document (TRD). This document serves as a point source vehicle for all performance verification and diagnostic procedures and equipment requirements to support the WRA in its maintenance environment, whether supported manually or via ATE.

c. In addition, System and Equipment Test Requirement Analyses may also be utilized to define and refine the quantity and type (i.e., Manual or Automatic) of off-line equipment required to support Avionic Equipment suits and associated GSE (Ground Support Equipment) as a system.

d. The contractor shall submit/update this report and content as appropriate to each phase of development (i.e., for the conceptual, validation, full scale development or production) specified by the contract.

## SYSTEM/DESIGN TRADE STUDY REPORTS

## Preparation Instructions (Continued)

10.3 Content (Continued)

e. The system TRA shall describe the System Level Maintenance Strategy at the "O" Level plus set "Design to Requirements" for the equipment to be tested at the "I" and "D" Level as well. The system TRA should concentrate on description of test methods, organization of system architecture, determination and location of individual equipment test points, and create the documentation base-line necessary to support and describe the maintenance philosophy of the system. A logical sequence of data development and the manner in which data should be reviewed, verified, and utilized must also be stipulated and established in the System Level TRA. A preliminary TRA should be provided as part of the contractor's original proposal during a program's Conceptual Phase and should be subsequently updated as the design progresses and upon conclusion of the program's Validation and Full Scale Development Phases.

f. The contractor shall describe how he plans on validating his System Maintenance Concept at the Organizational Level. This validation should take the form of a BIT fault detection/isolation (F/I) demonstration performed on an Advanced Development Vehicle during the Validation Phase of program development. The validation plan should stipulate how, when, and where this demonstration is to be performed. The demonstration shall exercise the Operational Readiness Test to validate the testability, maintainability, and supportability features of the equipment designed.

g. The equipment TRA shall describe the functional end-to-end (E/E) test requirements and fault isolation test procedures required for each UUT to be consistent with the Maintenance Concept stipulated in the System Level TRA. Equipment TRAs should be performed in accordance with MIL-STD-1519 and submitted for each UUT in two major stages. A Preliminary or End-to-End TRA should be provided for each UUT identified by the contractor as an Off-Line Candidate prior to the conclusion of the Validation Phase of Program Development. A more detailed TRA encompassing both an up-date of the preliminary E/E Functional test requirements, Fault Isolation Procedures and test techniques should be submitted during the Full Scale Development Phase. The TRA shall be kept current throughout the Life Cycle of the individual equipments being procured.

h. The contractor's off-line ATE selection shall be detailed to show the proposed solution of an optimum ATE/Manual Support Vehicle/Vehicles per the considerations stipulated in the Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment. Primary consideration should be given to existing GFE (Government Furnished Equipment) ATE Assets in lieu of new systems. (Applicable to Full Scale Development Phase).

SYSTEM/DESIGN TRADE STUDY REPORTS

Preparation Instructions (Continued)

10.3 Content (Continued)

i. The contractor's off-line F/I demonstration plan shall describe the plans validating the Intermediate and/or Depot Level Maintenance Concept. The validation should take the sum of individual fault isolation demonstrations performed on Full Scale Development UUTs utilizing ATE and/or manual test equipment. (Applicable to Full Scale Development Phase).

j. Test Program Set (TPS) elements required to test and fault isolate a UUT Off-Line should be generated upon conclusion of an individual UUT's F/I demonstration. This data should include but is not restricted to: (1) Test Program Tape or Cassette, (2) Test Program Instruction, (3) Any Interconnection Devices or Interface Hardware, (4) Final Test Requirements Document, and (5) Test Diagrams. (Applicable to Full Scale Development Phase).

k. The contractor's test program set fault isolation demonstration results shall describe the following for each UUT Fault/Isolation demonstration performed: (1) Fault names inserted referenced to applicable documentation and schematics, (2) Results of each fault inserted and where applicable reason/reasons why fault was not isolated properly, and (3) Detailed plans as to corrective action to be taken on all undetected faults or false diagnostics incurred during the F/I demonstration. (Applicable to Full Scale Development Phase).

l. The contractor's TPS/TRD UPDATE PLAN shall describe how he plans to upgrade individual Test Program Sets and TRDs based upon the F/I demonstration and Unsatisfactory Reports (URs) from the field activities. (Applicable to Full Scale Development Phase).

10.4 Changes. Whenever changes to the end item are made or contemplated, the contractor shall provide revision material for this report to reflect the change. Revised material shall bear the same page numbers as those pages which are to be replaced, plus the word "revised" and the date of revision. Additional pages shall bear the same page number as the preceding page followed by a lower case letter unless the additional pages follow the last page of the report. Revised or added material shall include a revised title page indicating the date of the revision. The revised title page shall contain the information contained on the original title page plus a revised index of revisions.



CONTRACT DATA REQUIREMENTS LIST										ATE/UUT			
ATCH NR		TO EXHIBIT		SYSTEM ITEM		Compatibility		CONTRACTOR		DISTRIBUTION AND ADDRESSES			
TO CONTRACT PR		CATEGORY		CONTRACTOR		CONTRACTOR		CONTRACTOR		CONTRACTOR			
1. SEQUENCE NUMBER	2. TITLE OR DESCRIPTION OF DATA	3. SUBTITLE	4. AUTHORITY (Data Item Number)	5. CONTRACT REFERENCE	6. TECHNICAL OFFICE	7. DD250 REQ	8. APP INPUT	9. COORDINATING	10. AS OF DATE	11. DATE OF SUBSEQUENT SUBM EVENT ID	12. DATE OF 1ST SUBMISSION	13. DATE OF SUBSEQUENT SUBM EVENT ID	14. DISTRIBUTION AND ADDRESSES (Audience - Regular Copies, Report Copies)
1.	System/Design Trade Study Reports												
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DATA ITEM DESCRIPTION		2. IDENTIFICATION NO(S).	
		AGENCY	NUMBER
1. TITLE  TEST PROGRAM SET CONFIGURATION MANAGEMENT PLAN			
3. DESCRIPTION/PURPOSE  The Test Program Set Configuration Management Plan defines the Contractor's policies and procedures for implementing the requirements specified in the Configuration Management Specification.		4. APPROVAL DATE	
		5. OFFICE OF PRIMARY RESPONSIBILITY	
		6. DDC REQUIRED	
		8. APPROVAL LIMITATION	
7. APPLICATION/INTERRELATIONSHIP  The Test Program Set Configuration Management Plan shall describe the methods to be used by the contractor to implement the Configuration Management Specification.		9. REFERENCES (Mandatory as cited in block 10)	
		MIL-STD 480, 481, 483	
		MCSL NUMBER(S)	
10. PREPARATION INSTRUCTIONS			
1. The Test Program Set Configuration Management Plan shall describe the methods by which compliance with the Configuration Management Specification will be accomplished.  2. The plan shall not be used to alter, modify or supersede the CM Specification requirements.  3. MIL-STD-483, Appendix I may be used for additional guidance.  4. The format requirements shown below apply.			

TEST PROGRAM SET CONFIGURATION MANAGEMENT PLAN

CONFIGURATION MANAGEMENT PLAN FORMAT

- SECTION I            GENERAL
  - A.    Introduction
  - B.    Compliance and Precedence
  - C.    Organization and Responsibilities
- SECTION II          IDENTIFICATION CONTROL
  - A.    Specifications
  - B.    Drawings
  - C.    Equipment/Hardware/Software
  - D.    Release Records
- SECTION III        CONFIGURATION CONTROL
  - A.    Baselines
  - B.    Change Control
  - C.    Deviations and Waivers
- SECTION IV        CHANGE VERIFICATION SYSTEM
  - A.    Verification Records
- SECTION V          CONFIGURATION MANAGEMENT AUDITS
  - A.    Configuration Management Systems Audits
  - B.    Physical Configuration Audit (PCA)
- SECTION VI        SUBCONTRACTOR/SUPPLIER AUDITS

CONTRACT DATA REQUIREMENTS LIST										SYSTEM ITEM <u>ATE/UUT Compatibility</u>		CONTRACTOR _____	
ATCH NR _____ TO EXHIBIT _____		CATEGORY _____		1. TITLE OR DESCRIPTION OF DATA		6. TECHNICAL OFFICE		10. FREQUENCY		12. DATE OF 1ST SUBMISSION		14. DISTRIBUTION AND ADDRESSES (Addressee - Regular Copies Refer Copies)	
1. SEQUENCE NUMBER	2. SUBTITLE	3. AUTHORITY (Data Item Number)	4. CONTRACT REFERENCE	5. DD250 CODE TO IAC REQ (A)	6. APP INPUT (A)	7. 8. 9. 10. 11. 12. 13. 14. 15. TOTAL	16. REMARKS	17. DATE OF SUBSEQUENT SUBM EVENT ID	18. 19. 20. 21. 22. 23. 24. 25. TOTAL	26. DATE	27. 28. 29. 30. 31. 32. 33. 34. 35. TOTAL	36. DATE	
13			Test Program Set Configuration Management Plan				1. Initial submittal 45 days after receipt of order. 2. Submit revisions as required to reflect any changes to suppliers internal configuration management procedures.	Blk 16 Blk 16		3/0			
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DATA ITEM DESCRIPTION		2. IDENTIFICATION NO(S).	
		AGENCY	NUMBER
1. TITLE			
EXCEPTION TO STANDARD ELECTRONIC MODULES (SEM)			
3. DESCRIPTION/PURPOSE		4. APPROVAL DATE	
Requests for exception to SEM requirements provides technical and economic justification by the supplier in order that SEM requirements may be waived by the buyer.		5. OFFICE OF PRIMARY RESPONSIBILITY	
		6. DDC REQUIRED	
		6. APPROVAL LIMITATION	
7. APPLICATION/INTERRELATIONSHIP		8. REFERENCES (Mandatory as cited in block 1)	
Requests for exception to SEM requirements are initiated by the supplier when SEM requirements (existing modules and/or new module design requirements) are determined to be unsuitable for system hardware requirements or portions thereof.		MIL-STD-1378	
		MCSL NUMBER(S)	
10. PREPARATION INSTRUCTIONS			
<p>1. Requests shall be in the form of written letter reports, providing the supplier's justification for a deviation or waiver to specific SEM requirements. In instances where cost effectiveness is the basis for exception, the cost model information shall be prepared by the supplier in accordance with provisions of the <u>Cost Effectiveness Model</u> of MIL-STD-1378 in addition to other applicable items of the format below.</p> <p>2. The report shall contain as a minimum, the following:</p> <ul style="list-style-type: none"> <li>a. Contractor Name.</li> <li>b. Contractor Number.</li> <li>c. Nomenclature or description of major equipment component.</li> <li>d. Identification of part and/or the identification of the technical requirement under consideration.</li> <li>e. Technical viewpoints, pro and con with justification.</li> <li>f. Economic viewpoints, pro and con with practical cost/expenditure formulation and justification.</li> <li>g. Alternate approaches to include narrative information, illustrations, graphic or schematics as applicable.</li> <li>h. Tradeoffs involving patents or proprietary data (rights in data) if applicable.</li> <li>i. Name of engineer or representative preparing report, his telephone number and mailing address.</li> <li>j. Signature of company official.</li> </ul>			



EXCEPTION TO STANDARD ELECTRONIC MODULES (SEM)

Preparation Instructions (Continued)

3. The above cited document, of the issue in effect on the date of invitation for bids or request for proposal, form a part of this Data Item Description to the extent specified herein.

ATCH NR _____ TO EXHIBIT _____		CONTRACT DATA REQUIREMENTS LIST										ATE/UUT	
TO CONTRACT PR _____		CATEGORY _____										SYSTEM ITEM Compatibility _____	
CONTRACTOR _____													
1. SEQUENCE NUMBER	2. TITLE OR DESCRIPTION OF DATA	3. SUBTITLE	4. AUTHORITY (Data Item Number)	5. CONTRACT REFERENCE	6. TECHNICAL OFFICE	7. APP INPUT DD240 COG TO IAC REQ (AI)	8. APP INPUT (AI)	9. AS OF DATE	10. FREQUENCY	11. DATE OF SUBSEQUENT SUBM EVENT ID	12. DATE OF 1ST SUBMISSION	13. DATE OF SUBSEQUENT SUBM EVENT ID	14. DISTRIBUTION AND ADDRESSEES (Addressee - Regular Copies, Return Copies)
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
14	Exception to Standard Electronic Modules (SEM)												
Requests for exception to SEM requirements shall be initiated by the Contractor when SEM requirements (existing modules and/or new module design requirements) are determined to be unsuitable for system hardware requirements or portions thereof.													
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
15.	TOTAL												
16. REMARKS													
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
15.	TOTAL												
16. REMARKS													
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
15.	TOTAL												
16. REMARKS													
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
15.	TOTAL												
16. REMARKS													
PREPARED BY _____ DATE _____ APPROVED BY _____													

APPENDIX G

POLICIES AND PROCEDURE ANALYSIS  
CONCEPTUAL PHASE

## 1.0 INTRODUCTION

This report is the first of four reports to be generated as part of the policies and procedures task item. The object of this report is to provide a comprehensive work breakdown structure (WBS) for ATE related activities to be undertaken during the conceptual phase of program development for Navy weapon systems. This work breakdown structure will provide a baseline for the review, analysis, modification, and generation of policies and procedures germane to the ATE process during the conceptual phase of program development. This WBS, when integrated into the Acquisition Planning Guide, will ultimately provide a consistent framework for:

- o Assisting project personnel in planning and assigning responsibilities for ATE related activities during the conceptual phase of program development.
- o Assisting project personnel in controlling and reporting progress on conceptual phase trade studies and support activities.
- o Establishing a data base for estimating the support costs for a Navy weapon system during the conceptual phase of program development.

The basis for this report is the Conceptual Phase portion of Figure 1-1 (Functional Flow of Acquisition Activities) of the Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment. The conceptual phase work breakdown structure, as depicted by this document, is shown in Figure G-1. Figure G-2 depicts an augmented WBS derived as a result of studies conducted under the policies and procedures task item.

## 2.0 CONCEPTUAL PHASE WBS

Comparison of Figures G-1 and G-2 indicates that the primary differences in the WBS is in the area of ATE trade-off analysis. With this in mind, the following discussion is limited to this aspect of the conceptual phase WBS.

Prior to the publication of the ATE acquisition guide, no suitable tool existed for performing test equipment trade-off analysis. Subsequently since its release, the test equipment effectiveness model (TEEM) has come upon the scene. The test equipment effectiveness model was developed by the Naval Weapons Engineering Support Activity (ESA-8) under sponsorship of Headquarters, Naval Material Command (MAT 04T).

The model is a computerized tool which can assist project personnel in determining the mix of test equipment best suited to support an end-item. The user must supply deployment, prime equipment, and test equipment data to the model. The model utilizes this data together with internal default data (i.e., shipping costs, facility overhead costs) to provide estimates of the following parameters:

- o Prime system availability (projected)
- o Quantities of support equipment required per site



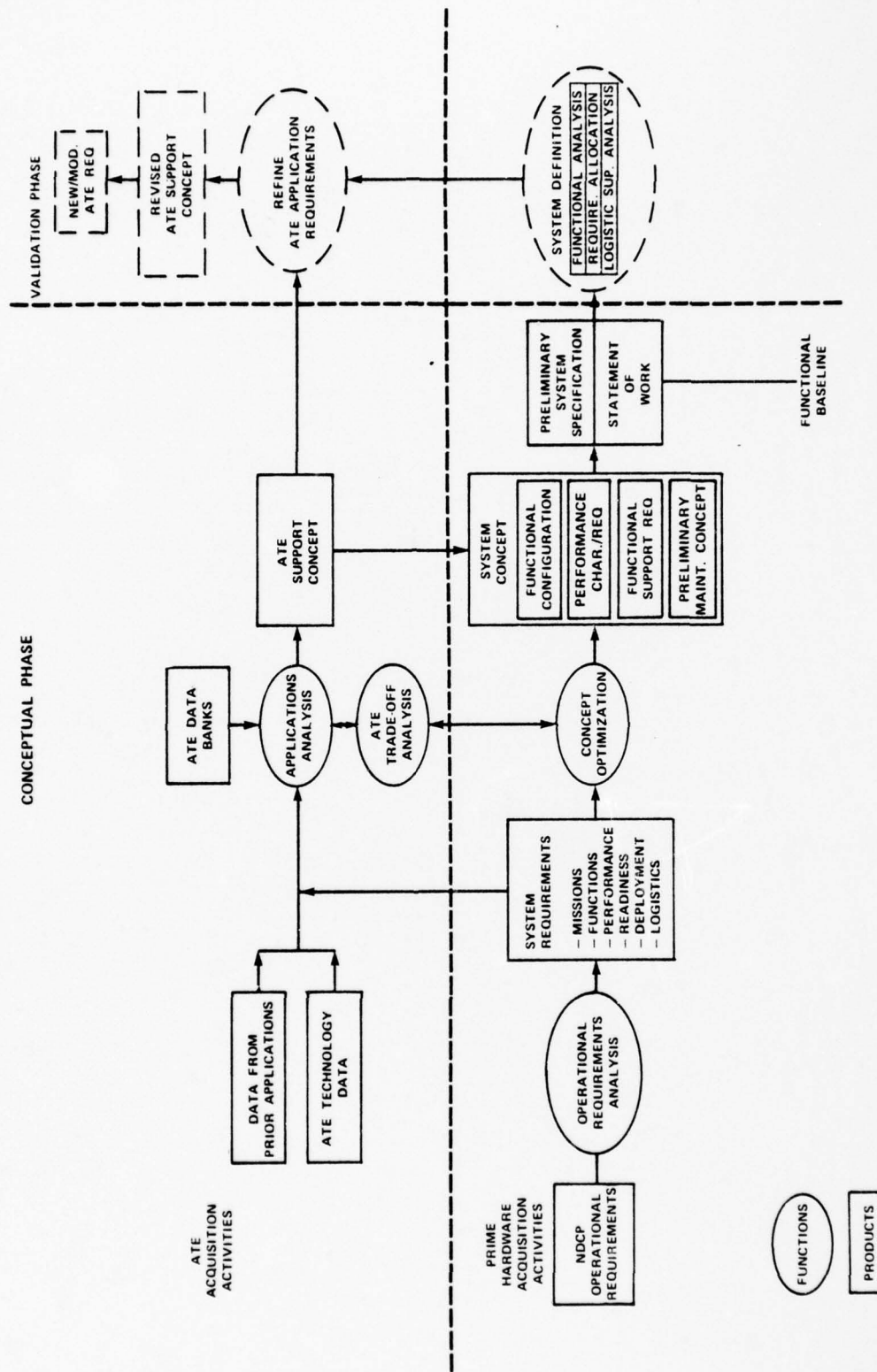


Figure G-1. Conceptual Phase WBS – Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment.



- o Test personnel required per site
- o Queueing estimates
- o Recurring and non-recurring costs per test equipment site
- o Failure rate sensitivity analysis.

The model is used by selecting several test scenarios and supplying the pertinent data for each. Manual comparisons are then made of the resultant output estimates to select the best of the alternate approaches used. Of itself, the model does not optimize between alternate approaches. The model does not satisfy the requirements for a level of repair (LORA) or life cycle cost (LCC) analysis. It is instead a supplement to these analyses. Generalized repair versus discard decisions must be made prior to using the model. The model provides the following advantages:

- o Rapid analysis and cost prediction for comparative evaluation of maintenance/support philosophies.
- o Cost sensitivity analysis vice prime equipment removal rate.
- o Simplified input format, tailored to the level of data available in a program planning stage.

At present, the model has the following limitations:

- o Inability to handle real-world situations, in which a mix of test equipments may be proposed at each test site.
- o Inability to perform a queueing analysis for more than one UUT across a tester. That is, perform calculations which steer one to the "optimum" support vehicle.
- o Inability to allow for interaction with the user, for example, in modification of the default values. For this, a programmer is required to alter the model source deck.
- o Inability to consider the costs of BIT, within the model, as contributing to support costs.

Conceptually, the above limitations may be overcome by the user if he is familiar enough with the mathematics of the model to alter his source data, or analyze the output data, to compensate for model performance (in effect, to trick the model into doing the right thing).

### 3.0 SHORT TERM RECOMMENDATIONS

The following short term recommendations are made relative to the TEEM model:

- o Solutions and cost estimates should be solicited by MAT 04T from the Naval Weapons Engineering Support Activity (ESA-8) to accomplish the following:
  - Modify or add a front end program to allow the TEEM model to be used in a real world situation (i.e., accommodate several testers at each level of test).
  - Modify the TEEM model to provide a BIT related cost factor.
  - Modify the TEEM model to permit user interaction for alteration of assumed or default values.
  - Modify the TEEM model to allow queuing analysis for more than one UUT across a given tester.
- o After the above mentioned recommendations have been implemented, it is recommended that the TEEM model be benchmarked (i.e., validated) against a real life test scenario.
- o Obtain resource estimates from ESA relative to providing TEEM support for the three SYSCOMs.

### 4.0 LONG TERM RECOMMENDATIONS

The following long term recommendations are made relative to two major elements (data banks, ATE trade-off analysis) which comprise the conceptual phase WBS:

- o The present data banks covered under NAVMAT Instruction 5230.8 are woefully out of date and do not address the needs of the user. Write a specification (i.e., input/output data requirements for a data bank which could be used throughout the ATE selection process - from very general support requirements developed in the conceptual phase to the finalization of specific test requirements in the production phase. The subject data bank must have family of tester data relevant to the needs of the three SYSCOMs and also satisfy the input data requirements of the TEEM model. Keep the data bank current. Benchmark the data bank and then generate an instruction advertising its existence.
- o Generate an instruction advertising the existence of the TEEM model upon successful completion of its validation by an independent authority.



## 5.0 REFERENCES

- (a) Test Equipment Effectiveness Model User's Guide, U.S. Naval Weapons Engineering Support Activity - Management Engineering Department, 6 January 1977.
- (b) NAVMAT Instruction 5230.8, Data Banks for Automatic Test, Monitoring and Diagnostic Systems and Equipment; Utilization of, 14 November 1974.
- (c) Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment, Test and Monitoring Systems Office (MAT 04T), 1 July 1976.

APPENDIX H

POLICIES AND PROCEDURES ANALYSIS  
VALIDATION PHASE

## 1.0 INTRODUCTION

This report is the second of four reports to be generated by ManTech of New Jersey Corporation as part of the policies and procedures task item. The object of this report is to provide a comprehensive work breakdown structure (WBS) for ATE related activities to be undertaken during the validation phase of program development for Navy weapon systems. This work breakdown structure will provide a baseline for the review, analysis, modification, and generation of policies and procedures germane to the ATE process during the validation phase of program development. This WBS, when integrated into the Acquisition Planning Guide, will ultimately provide a consistent framework for:

- o Assisting project personnel in planning and assigning responsibilities for ATE related activities during the validation phase of program development.
- o Assisting project personnel in controlling and reporting progress on validation phase trade studies and support activities.
- o Establishing a data base for estimating the support costs for a Navy weapon system during the validation phase of program development.

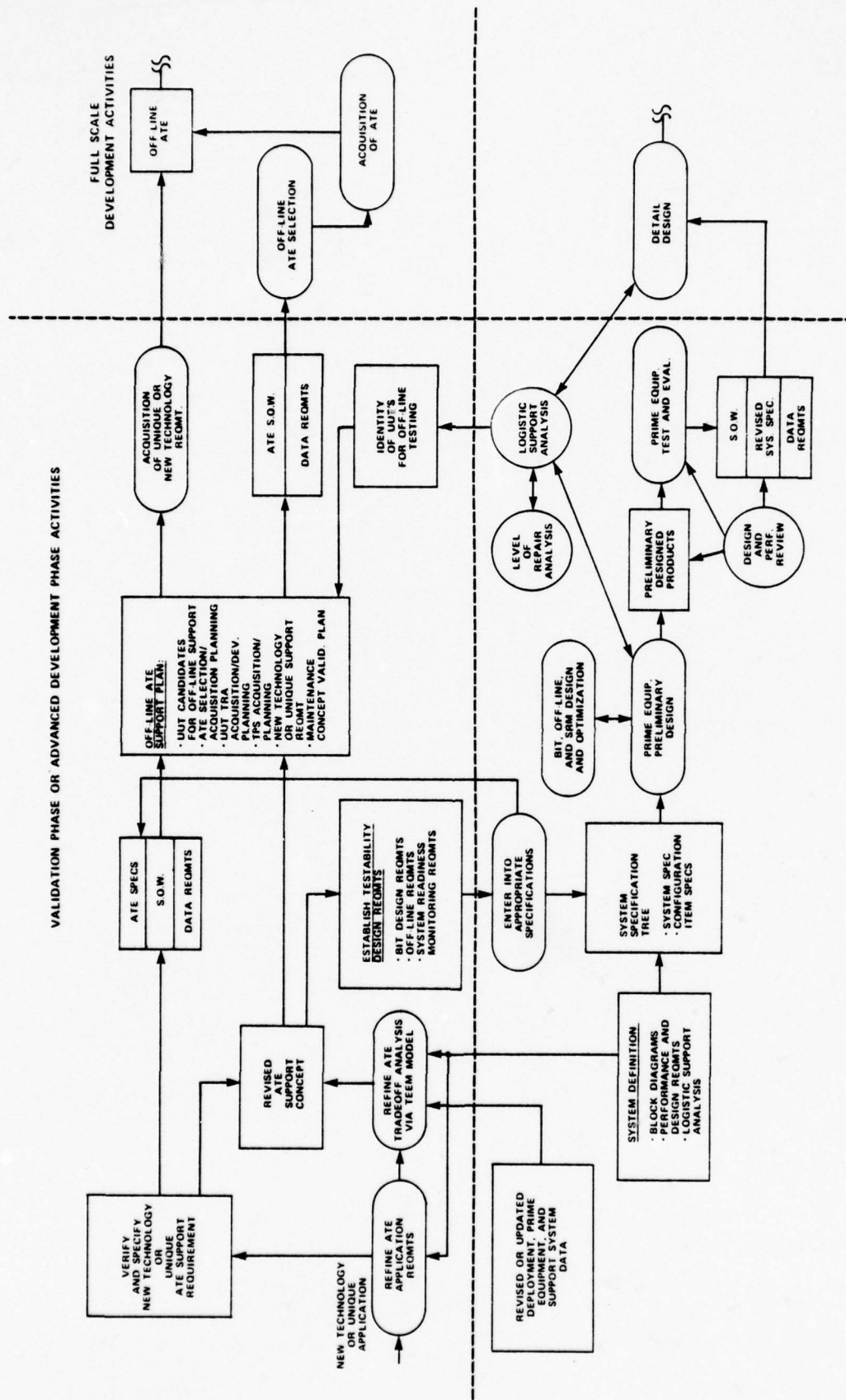
The basis for this report is the Validation Phase portion of Figure 1-1 (Functional Flow of Acquisition Activities) of the Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic System and Equipment. The validation phase work breakdown structure as depicted by this document is shown in Figure H-1. Figure H-2 depicts an augmented WBS derived as a result of studies conducted under the policies and procedures task item.

## 2.0 VALIDATION PHASE WORK BREAKDOWN STRUCTURE

Comparison of Figures H-1 and H-2 indicates that the primary differences in the WBS of ATE related activities lies in the area of refining ATE application requirements. With this in mind, the following discussion is for the most part limited to this aspect of the validation phase WBS. In the development of a modern weapon system, the technology of the elements to be maintained are typically more advanced than the ATE technology available to support these end items off-line. During the conceptual phase of program development, the areas of advanced technology development contemplated should be extracted from the preliminary prime system performance characteristics. This information should be compared with current ATE technology and voids in testing technology identified. Upon entering the validation phase of program development, (see Figure H-2) unique or advanced (new) technology support requirements for system configuration end items should be verified and specified. The verification process consists of surveying the current technology marketplace and verifying that the end item in question requires special off-line support considerations. System functional (block) diagrams and performance requirements which evolve during the validation phase of program development are key tools in discerning whether advanced technology ATE or ATE currently available in the commercial and military inventory can support the weapon system under development.







An objective unbiased technology assessment during the validation phase of program development is a prerequisite for avoiding underestimation of a weapon system support problem which will become quite apparent in later stages of program development. Confirmation that an advanced technology support requirement exists is a strong argument for the inclusion of BIT as part of the new weapon system design for both RFI (performance) and diagnostic testing. Where this approach does not appear operationally or economically feasible, suitable off-line advanced technology support requirements must be specified and planned for. In either case, the results of trade studies which mandate adherence to the support concept must be reflected in the revised ATE support concept for the prime weapon system.

Advanced technology or unique support requirements should be documented via a support equipment specification. A statement of work and associated data requirements should also be prepared for submittal with the RFP for acquisition of advanced technology or unique ATE. Prior to RFP release, the planning and acquisition requirements for advanced technology ATE should be established and documented in the off-line ATE support plan for the weapon system being supported.

As indicated in Figure H-2, the TEEM model should be utilized during the validation phase to further refine the ATE support concept for those UUTs that appear to be compatible with present day ATE technology. Updated deployment, prime equipment, and support system data (available via data banks) in unison with a more finely defined prime system architecture will enable TEEM analysis to divulge the optimum system support strategy.

Harmonization of the delivery of advanced technology support tools with readily available off-line ATE selected and acquired during the full scale phase of program development is highly desirable. However, experience has shown that such an occurrence is highly unlikely. Early identification of advanced testing technology requirements in the conceptual phase and the timely verification of the requirement and specification in the validation phase is mandatory to ensure support system success. Any delay incurred in contracting and developing advanced technology support tools during the validation phase will have an adverse effect on satisfying test program set and R&M demonstration requirements required in the full scale development phase of program development. This effect may in turn have an adverse effect on advanced technology ATE deliveries during the production phase of program development.

### 3.0 SHORT TERM RECOMMENDATIONS

When conducting program reviews and consultation under the MAT 04T umbrella, require that a technology assessment of proposed configuration end items versus ATE technology available be conducted during the conceptual and validation phases of program development. As an example, the aspect of technology assessment is currently being pursued in the RPV program via close coordination between AIR 534 and ManTech. Advanced or new technology configuration end items for this particular program should be identified by August of this year.

#### 4.0 LONG TERM RECOMMENDATIONS

Create policies and procedures which would assist project managers in conducting end item versus ATE technology assessment in some standard or normalized manner. Such a policy should be based on the marriage of UUT performance data versus ATE application data in a data bank. The output of the data bank analysis should be unambiguous - either ATE exists in the current inventory to support the designated end item or it doesn't. If the data bank analysis indicates new ATE is warranted, a LORA analysis would have to be performed to economically justify the utilization of the proposed new ATE. The LORA would have to take into consideration both the recurring and non-recurring development and operational costs for the new ATE which supports the configuration end item in question.

#### 5.0 REFERENCES

- (a) Test Equipment Effectiveness Model User's Guide, U.S. Naval Weapons Engineering Support Activity - Management Engineering Department, 6 January 1977.
- (b) Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment, Test and Monitoring Systems Office (MAT 04T), 1 July 1976.
- (c) Policies and Procedures Analysis - Conceptual Phase Work Breakdown Structure, Report prepared by ManTech of New Jersey Corporation for MAT 04T, 28 February 1977.

APPENDIX I

POLICIES AND PROCEDURES ANALYSIS  
FULL SCALE DEVELOPMENT



## 1.0 INTRODUCTION

This report is the third of four reports to be generated as part of the policies and procedures task item. The objective of this report is to provide a comprehensive work breakdown structure (WBS) for ATE related activities to be undertaken during the full scale development phase of program development for Navy weapon systems. This work breakdown structure will provide a baseline for the review, analysis, modification, and generation of policies and procedures germane to the ATE process during the full scale development phase of program development. This WBS, when integrated into the Acquisition Planning Guide, will ultimately provide a consistent framework for:

- o Assisting project personnel in planning and assigning responsibilities for ATE related activities during the full scale development phase of acquisition process.
- o Assisting project personnel in controlling and reporting design and development of first article UUT hardware and TPSs and ensure proper selection of ATE for maintenance support.
- o Establishing a data base for estimating the support costs for a Navy weapon system during the full scale development phase of program development.

The basis for this report is the Full Scale Development portion of Figure I-1 (Functional Flow of Acquisition Activities) of the Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic System and Equipment. The full scale development breakdown structure as depicted by this document is shown in Figure I-1. Figure I-2 depicts an augmented WBS derived as a result of studies conducted under the policies and procedures task item.

## 2.0 FULL SCALE DEVELOPMENT (FSD) PHASE WORK BREAKDOWN STRUCTURE

Comparison of Figures I-1 and I-2 indicates that the primary differences in the work breakdown structure during the FSD phase are in the areas of (1) Test Requirements Analysis (TRA), (2) TRD Management, (3) ATE selection, (4) TPS generation, (5) Configuration control of ATE, TPS, TRD and UUT related items.

2.1 TRA. TRA is a process which defines the functional end-to-end (E/E) performance requirements and fault isolation (F/I) test procedures which are required for each UUT to be consistent with the overall system maintenance concept. The input to TRA process is the UUT design data which is used during the analysis to determine test requirements. The UUT design data consists of drawings (schematics, logic diagrams, parts lists, etc.), failure and MTBF data, performance specification, theory of operation and mechanical/electrical interface definition. The output of equipment TRA process is recorded in appropriate sections of the TRD document for E/E and F/I test requirements. These functions are normally performed by the UUT designer having most familiarity with the unit, however, in a case of simple modules and throwaways, these functions can also be performed by other activities, such as TPS developer.

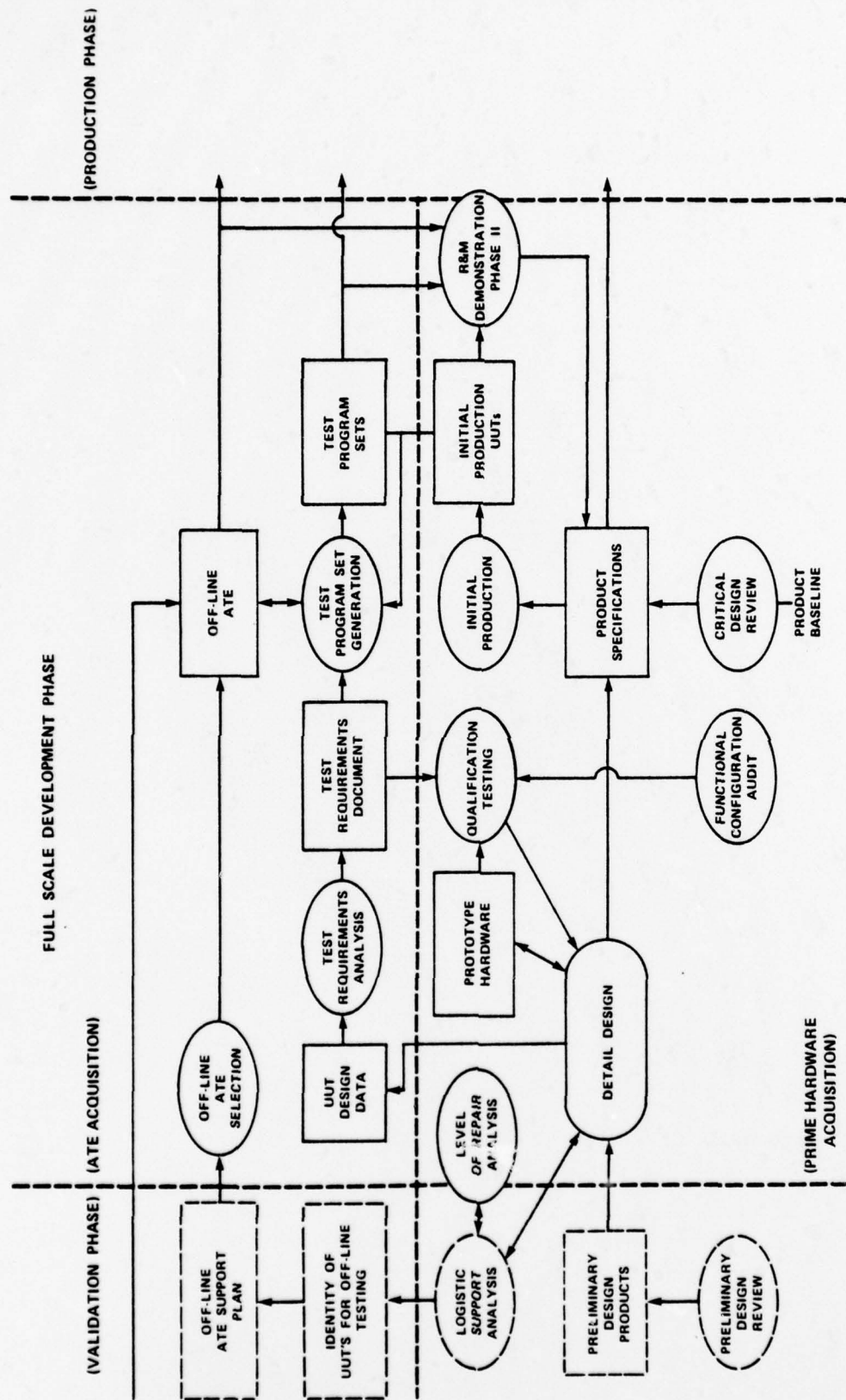


Figure 1-1. Full Scale Development Phase WBS – Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment.

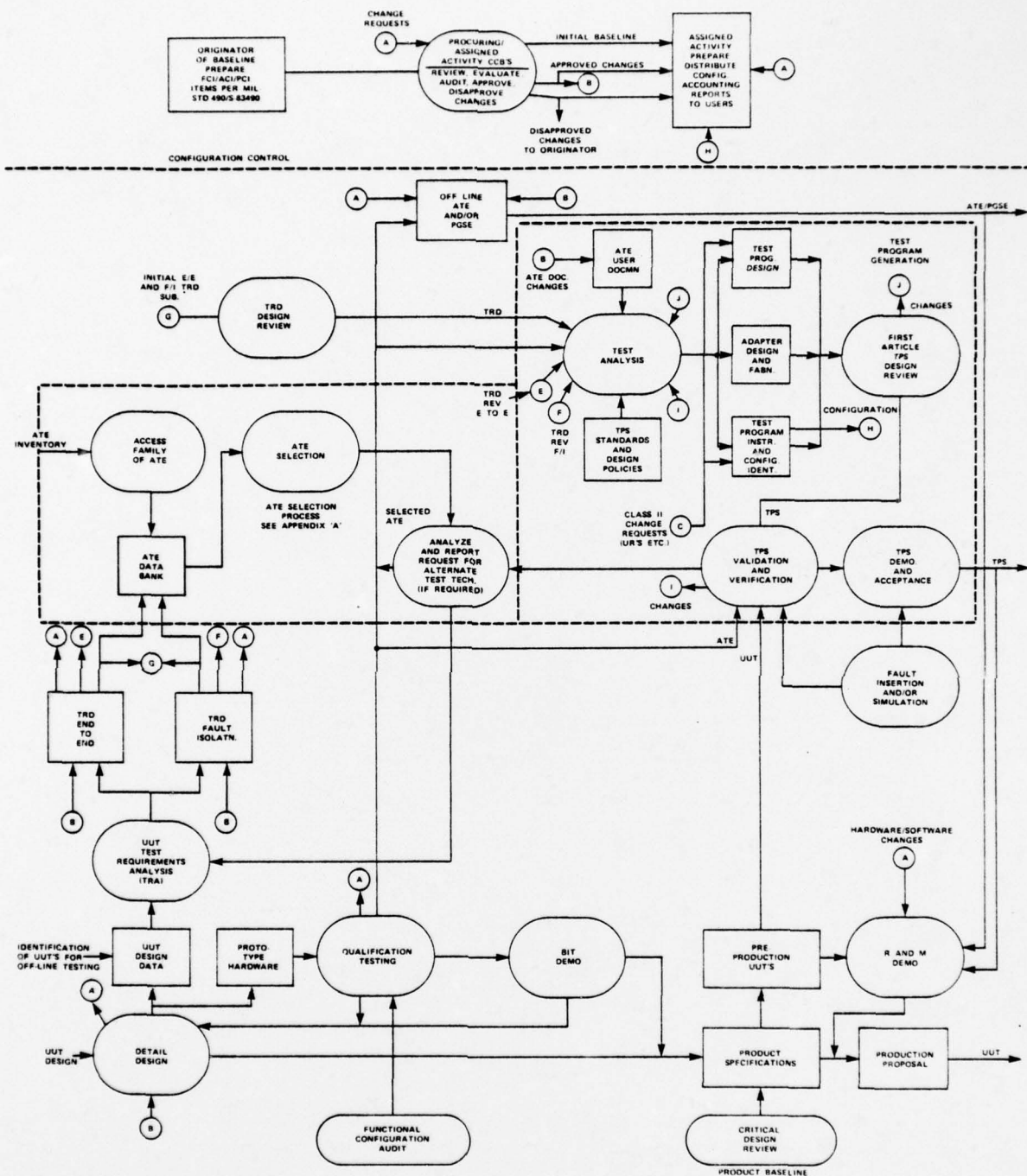


Figure 1-2. Full-scale Development Phase WBS Policies and Procedures Task Item.



2.2 TRD management. The purpose of the TRD specification is to identify the necessary data for development of cost-effective test programs and support of UUT. The document describes the format and content for detailed design data and includes separate E/E and F/I test requirements sections for the UUT. This document constitutes the formal interface between the contractor responsible for detailed design and test program developer. TRD also provides detailed configuration identification for UUT design and test requirements data. This data must be kept current with the UUT hardware design and performance changes in order to ensure compatible test programs. It must be a living document from which TPS developer can obtain source data to update TPSs for required UUT configuration levels. The initial preparation of TRD should also involve the TPS developer to ascertain that the test requirements and strategy are properly identified and noted in the TRD. This version of the TRD should be complete when the configuration of the first preproduction model is established and should contain all the essential elements required to develop effective TPSs. Subsequent revisions to the TRD should be processed via the change control process identified in paragraph 2.5. Initially, the TRD for end-to-end and F/I test requirements may be submitted separately for accessing the ATE data bank and commencement of TPS development. However, there is a certain degree of risk and penalty involved in terms of cost and schedule impact on TPS generation when the ATE selection process reveals different ATEs for each test case. The obvious objective is to select one common ATE which must satisfy both test conditions. Ideally, the ATE selection process should be based on the combined submittal of TRD for E/E and F/I testing requirements to minimize impact on TPS development.

2.3 ATE selection. The process of selecting off-line ATE has been added and is shown as part of TPS development activity. This task involves accessing a family of ATE testers and corresponding data banks, and comparing parametric data contained in the initial TRD document to arrive at a UUT/ATE compatibility matrix. The result of this compilation provides an input in the decision process in selecting the most compatible and optimum ATE candidates which will support the UUTs. In the event the family of ATEs cannot meet UUT test requirements, alternate test techniques may be requested from UUT developer. If that fails to resolve the problem, then the UUT must be off loaded to some other ATE or MTE. A more detailed explanation of the process in selecting ATE can be found in the Annex which follows immediately.

2.4 TPS generation. Test program generation process has been modified in order to emphasize the main tasks that are performed during development of test programs. There are three major areas which influence test program design: TRD, ATE user documentation and TPS standards and design policies (e.g., AR-9B). Since the TRD document contains precisely defined ATLAS test statements, the major TPS design effort will be to determine overall system error allocation for the UUT and the test set-up including the selected ATE. Guidelines with respect to system error budgeting allocation, i.e., test accuracy ratio (TAR) definition should be provided as part of TPS design policies. The output of test analysis results in detailed step-by-step test program design for E/E and F/I. In addition, the analysis also determines ATE/UUT



interface compatibility requirements for adapter design which is used to interface the UUT to selected ATE. Common adapter design should be utilized to interface as many UUTs as feasible in order to reduce cost and proliferation of different types of adapters. TPS validation and verification (V&V) should be performed on first article test program during the debugging process. V&V should be accomplished by manual insertion of faults in the UUT to demonstrate the capability of the test program to successfully detect the required level of fault isolation on the UUT. Preferably, automatic fault insertion simulation techniques should be used to verify fault detection and isolation capability of the test programs. Guidelines with respect to general acceptance of test programs should be generated in support of UUTs. In particular, the issue of fault insertion and detection criteria should be examined and established.

2.5 Configuration control of ATE, TPS, TRD and UUT related items. NAVMATINST 4130.1A identifies requirements for configuration management in terms of identification, control, reporting and implementation of configuration items (CIs) from validation through development and operational phases. In particular, there is a need for a change control board (CCB) during the full scale development phase. The functions of CCB are to review, evaluate, audit and approve/disapprove Class 1 ECP changes. The formal CCB process continues during other acquisition phases except that there is no need for configuration management during the conceptual phase. In functional terms, Figure I-2 identifies CIs which should be under configuration control for ATE applications and how it may affect TPS/ATE/UUT and TRD compatibility. Changes in any one of these areas can affect the maintenance capability for the UUT. Therefore, from the configuration point of view whenever changes are made to the ATE, UUT and TRD, it is essential that the TPS developer be notified of configuration level changes affecting the TPS. Compatibility can only be established by strict adherence to configuration control procedures which must be established for ATE applications.

### 3.0 SHORT TERM RECOMMENDATIONS

- o Finalize TRD and obtain concurrence from three SYSCOMs prior to end of FY 77. Ensure that this document contains sufficient and accurate information from which effective end-to-end and F/I tests can be generated in minimum of time and cost by the TPS developer.
- o Identify configuration control items for the entire ATE, TPS, UUT and TRD acquisition process and show the relationship and impact of changes to these end items. If feasible, determine standardized reporting method for ATE related configuration items.
- o Establish a methodology for the number of faults to be inserted and sampled during TPS verification and acceptance.
- o Determine responsibilities for work breakdown structures, e.g., TRA, TRD, TPS development, etc., and establish policies.

#### 4.0 LONG TERM RECOMMENDATIONS

- o Establish policies and procedures for the management of TRDs.
- o Develop tools for the selection of ATE from a family of testers. Presently, there is no standardized approach to be used in the selection process.
- o Generate design guide for TPS development and maintenance (similar to AR-9B) which will be applicable to three SYSCOMs. Also, develop design for testability document (similar to AR-10A).
- o Develop a tool which will provide off-line ATPG data that is ATE independent.
- o Establish P&P for BIT validation after qualification testing. As an example, BIT was not validated for the AWS NAVSEC Program. Also, BIT design guide NAVMATINST 3960.9 does not provide standardized strategy and test criteria for validation.
- o Generate configuration control guidelines for all ATE related items based on the functional flow of acquisition activities commencing with the product baseline. Include the guidelines in the next update of Acquisition Planning Guide as an appendix.

#### 5.0 REFERENCES

- (a) Configuration Management, Department of the Navy, NAVMATINST 4130.1A, 1 July 1974.
- (b) Acquisition Planning Guide for Automatic Test, Monitoring and Diagnostic Systems and Equipment, Test and Monitoring Systems Office (MAT 04T), 1 July 1976.
- (c) Policies and Procedures Analysis - Conceptual Phase Work Breakdown Structure, ManTech Systems Report prepared for MAT 04T, 28 February 1977.
- (d) Policies and Procedures Analysis - Validation Phase Work Breakdown Structure, ManTech Systems Report prepared for MAT 04T, 14 March 1977.
- (e) VAST TPS Cost Investigation, ManTech Systems Report for MAT 04T, 30 December 1976.
- (f) Report on Navy Issues Concerning Automatic Test, Monitoring and Diagnostic Systems and Equipment, Report prepared by ATE Ad Hoc Working Group for the Assistant Secretary of the Navy (Research and Development), 13 February 1976.
- (g) MIL-STD-881, Work Breakdown Structures for Defense Material Items.
- (h) Built-in-Test (BIT) Design Guide, NAVMATINST 3960.9, 9 September 1976.

ANNEX

ATE SELECTION PROCESS



## 1.0 ATE SELECTION PROCESS

Figure I-A1 describes in detail the process of determining a workable test scenario from alternative options. This scenario would include:

- o Test equipment selection
- o Support level selection
- o Cost prediction.

There are four main phases to this process:

- o Data assembly
- o UUT/ATE compatibility analysis
- o Test scenario evaluation/cost prediction
- o Report and recommendation.

1.1 Data assembly. The data required for selection of candidate ATEs are the data establishing the need to test a particular UUT, the parametric signal data and accuracies required at the UUT I/O interface, and the corresponding interface capability of candidate ATEs. The sources for such data include:

- o Level of Repair Analysis (LORA) for UUTs
- o UUT specifications/schematics
- o UUT TRDs, if existent
- o ATE interface specifications.

Other data to be assembled at this time should include ATE cost and space requirements, UUT cost and MTBF predictions and facility locations. These data are used later in evaluation of logistics cost and effectiveness.

1.2 UUT/ATE compatibility analysis. This is an interactive process in which the interface requirements of each candidate UUT (as determined by LORA) are compared against the interface capabilities of each candidate ATE. In general, there are five alternatives which may result from each UUT/ATE comparison:

- o The ATE is not compatible with the UUT and cannot be made so economically.



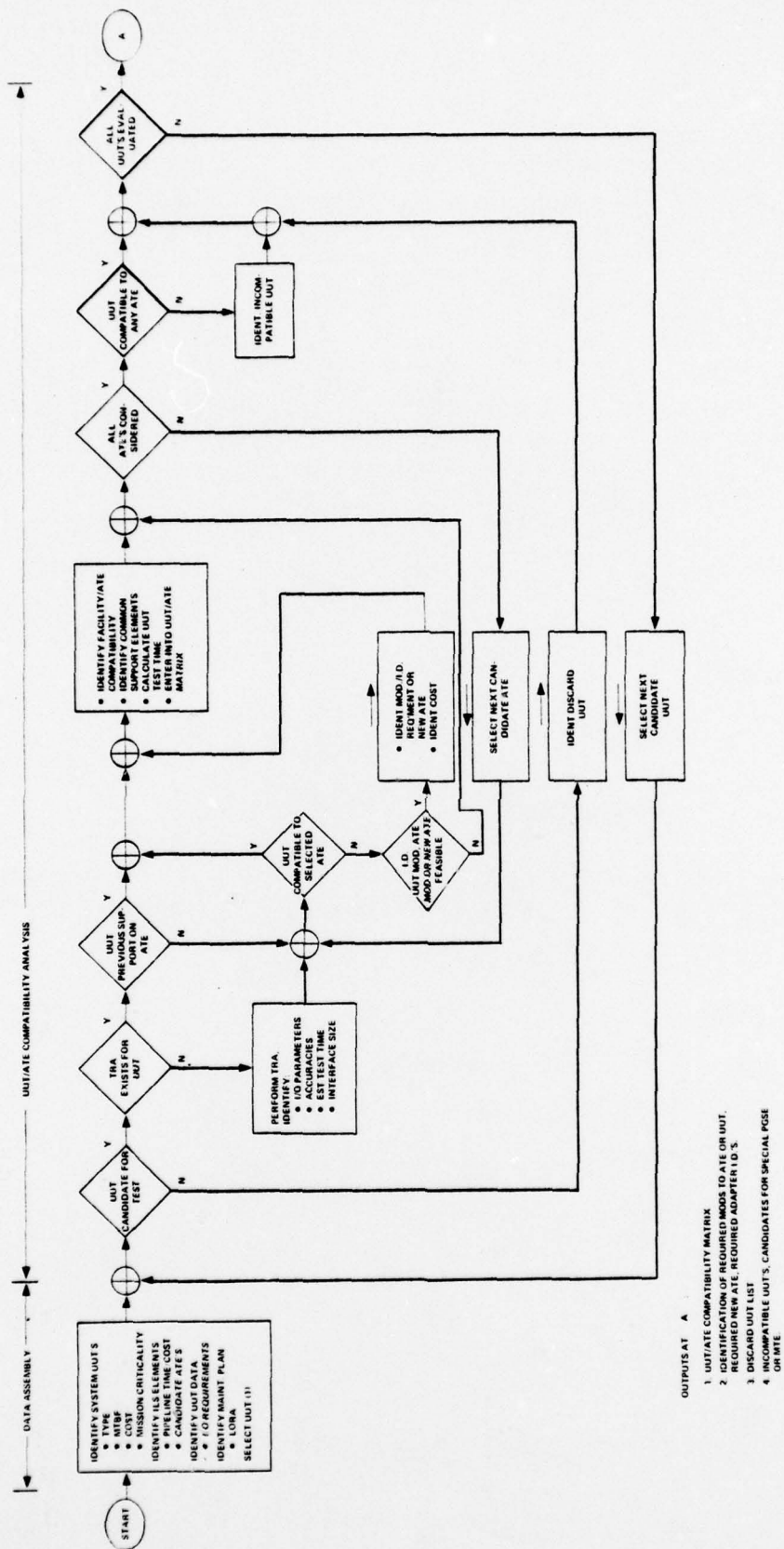
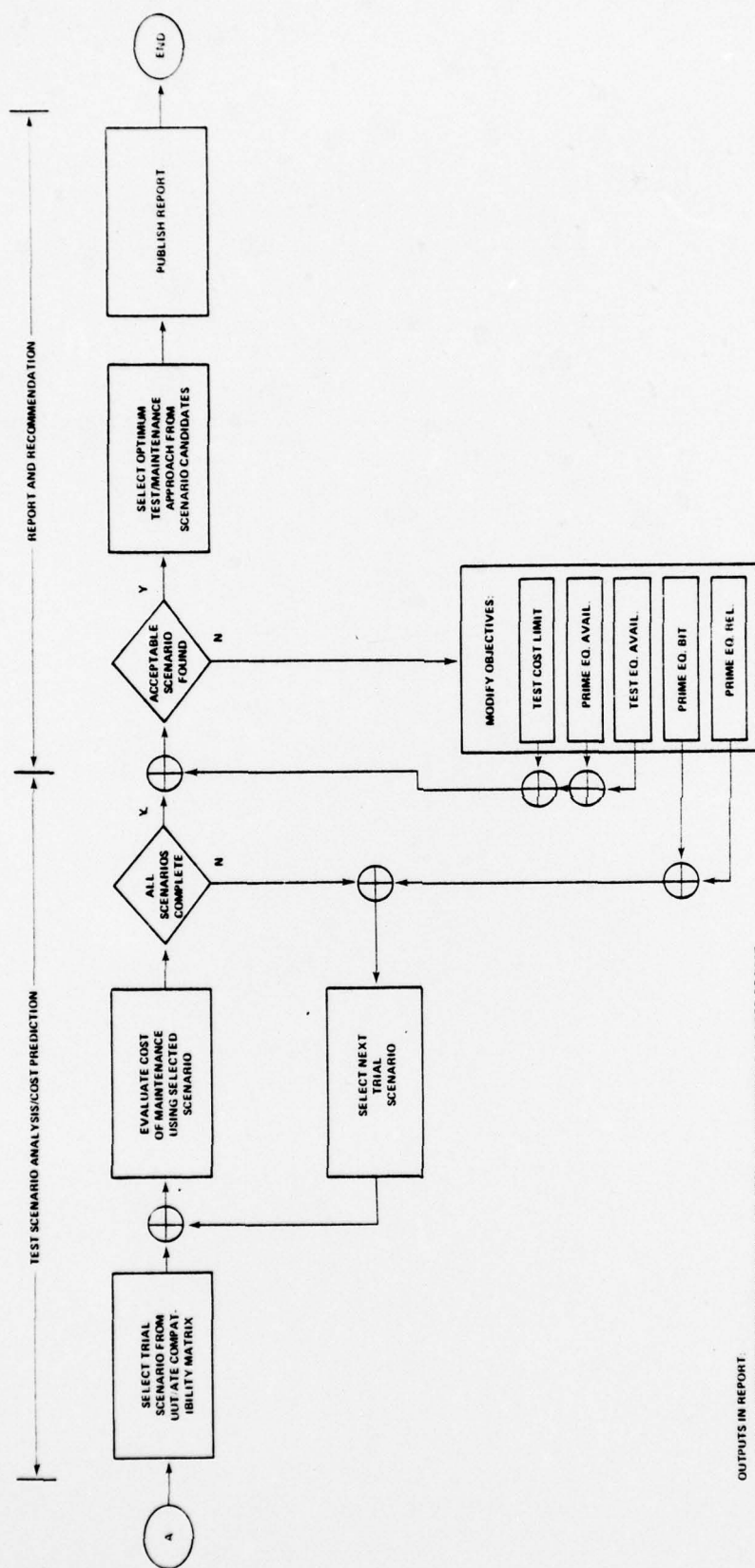


Figure I-A1. ATE Selection WBS -- Policies and Procedures Item.



OUTPUTS IN REPORT  
 1. FINAL SUPPORT RECOMMENDATION, ATE, PGSE, MTE SELECTIONS, DEGREE OF TEST AT O, I, D LEVELS  
 2. COST AND AVAILABILITY PREDICTIONS FOR RECOMMENDED SCENARIO  
 3. PRIME EQUIPMENT RECOMMENDATIONS (e.g. BIT, D FOR T, REL, MAINT.)

Figure I-A1. ATE Selection WBS - Policies and Procedures Item. (Cont'd)

- o Design-for-testability modifications can be made to the UUT to produce UUT/ATE compatibility.
- o The ATE is compatible with the UUT with passive interface circuits.
- o The ATE can be made compatible to the UUT with modification.
- o The ATE can be made compatible to the UUT via a complex (e.g., active) interconnecting devices (IDs)

In the cases of the last two alternatives, the cost elements necessary to modify the ATE or produce the complex ID must be estimated and carried into the next phase as a part of the support equipment costs.

Identification of an ATE/UUT compatibility match is completed by estimating UUT test time and by indicating the UUT/ATE compatibility, in matrix form.

1.2.1 UUT/ATE matrix. This document is a three-dimensional listing of UUT versus ATE support levels (O, I, D) possible. From the permutations of this list, possible test/support scenarios may be derived for evaluation in the next phase of the ATE selection process.

1.2.2 Compatibility analysis outputs. There are four outputs to be derived from the compatibility analysis phase:

- o The UUT/ATE compatibility matrix
- o The identification and estimated cost of required ATE mods or adapters.
- o The list of discard UUTs, i.e., those not considered cost-effective candidates for test.
- o The list of UUTs which must be tested, but whose testing is not cost-effective on ATE; therefore, candidates for PGSE or MTE support.

1.3 Test scenario analysis/cost prediction. The purpose of this phase is to systematically determine the optimal (i.e., most cost-effective) test scenario from the options developed under the compatibility analysis phase. This is done by judicious selection of a number of trial support scenarios from the compatibility matrix and application of cost estimate analysis to each selected trial scenario. One method for such analysis is the test equipment effectiveness model (TEEM). This program, available through ESA, utilizes UUT and ATE data, shipping and labor costs, and selected support scenario information to arrive at predictions of support costs, prime equipment availability, ATE availability and manpower and spares requirements. The predictions derived for various selected scenarios may be used as a measure of comparison for planning.



1.4 Report and recommendation. There are three primary outputs to this phase:

- o Final Support Recommendation (Optimum Scenario)
- o Cost and Availability Predictions
- o Recommendations for Prime Equipment.

1.4.1 Final support recommendation. This output consists of the description of the recommended support scenario, including:

- o Test equipment (ATE, PGSE, MTE) selected
- o Sites selected for test equipment use
- o UUTs assigned to specific test equipments
- o Spares recommendations.

1.4.2 Cost and availability predictions. This output consists of the estimates of acquisition and operating costs for prime equipment and test equipment support. It may be considered as the non-recurring and recurring costs of support. Included are manpower, transportation and spares cost estimates.

1.4.3 Recommendations for prime equipment. This output consists of any recommended prime equipment changes considered necessary to make the support scenario workable/more cost-effective. Examples of such recommendations might include:

- o Inclusion/augmentation of BIT
- o Design-for-testability changes
- o Reliability improvements.

To the extent that the inclusion of such changes to the prime equipment can be incorporated with minimal impact, the overall life cycle cost (LCC) of the weapon system may be reduced. For this reason, the ATE selection process should be integral to, and supportive of, the prime equipment design process.



ATTACHMENT 1

SUMMARY OF THE TEST REQUIREMENTS DOCUMENT

The test requirements document (TRD) establishes a definitive and precise set of requirements for UUT source documentation and procedures required in support of maintenance systems, subsystems, assemblies, and subassemblies. The TRD may be used to perform any or all of the following:

- a. Provide a standard data package which can be used to analyze a UUT in sufficient depth to facilitate its release for pre-production and/or production with a high level of confidence that provisions are provided in the design to align, fault isolate, and verify equipment operation.
- b. Provide a standard data package to the developer of a test program set (TPS) or a test procedure so that programs or procedures to align, fault isolate, and verify equipment operation may be developed.
- c. Develop test procedures to align, fault isolate, and verify equipment operation.
- d. Determine the test equipment, tools, and test fixtures required to support a UUT at any level of maintenance.
- e. Provide a vehicle in which data related to readiness and maintenance requirements be made readily available.

This document consists of the primary specifications and four appendices. The purpose of each appendix is as summarized below:

Appendix I - This appendix is titled: "Developmental Documentation and Non-Procedural Test Requirements."

This appendix provides a standard data package which can be used to analyze a UUT in sufficient depth to facilitate its release for pre-production and/or production with a high level of confidence that provisions are provided in the design to align, fault isolate and verify equipment operation. As a standard data package it can be used by the developer of a test program set or a test procedure so that programs or procedures to align, fault isolate, and verify equipment operation may be developed. It is a vehicle for determining the test equipment required to support a UUT at any level of maintenance.

Appendix II - This appendix, "Summary Description of ATLAS," provides an overview in the utilization of ATLAS as a standard abbreviated English language in the preparation and documentation of non-procedural or procedural test requirements.

Appendix III - This appendix, "Application of UUT Failure Rate Data," provides, via standardized forms, the capability of recording reliability failure rate data. This data can be utilized to effect fault isolation/diagnostic test design and also provides a vehicle to validate the attainment of fault isolation Ambiguity Group Requirements specified by the procuring agency.

Appendix IV - This appendix is titled: "Production Documentation and Procedural Test Requirements." This appendix is similar to Appendix I but it provides in addition to documentation, detailed procedures to align, fault isolate, and verify equipment operation. In addition, it provides a vehicle for determining the test equipment, tools, and test fixtures required to support a UUT at any level of maintenance.

Documentation and non-procedural test requirements may be procured as per Appendix I for equipments where this information is required, but configuration baseline or system design data is not of a mature nature. Data also may be procured as per Appendix I where the procuring agency intends to utilize the documentation and test requirements information provided as first generation inputs and later refine them via other contractual vehicles.

Documentation and procedural test requirements may be procured as per Appendix IV for those equipments where the procuring agency believes that a minimum amount of risk is associated with contracting directly for procedures based on equipment maturity or other factors. Where equipment is of an immature nature but the procuring agency is in need of procedural test requirements, data may be procured as per Appendix IV but this data should be monitored and controlled by a suitable configuration control plan of action.

Throughout this specification the utilization of the ATLAS language for describing procedural and non-procedural test requirements is specified regardless of whether ATE or semi-automatic test equipment is contemplated to be utilized.

ATLAS is an accepted industry standard and is dedicated to defining the test requirements of a unit under test with no reference to, nor dependence upon the test equipment which may be used. For those instances where ATLAS cannot adequately describe test requirements in an unambiguous fashion, this specification defines certain minimum data requirements which must be supplied as part of the TRD to rectify these anomalies.